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RDTE PROJECT NO. 1X141807D174
USAAVCOM PROJECT NO.
USAAVNTA PROJECT NO. 66-06

AD832820

FEASIBILITY TEST OF TRACTOR TAIL ROTOR MODIFICATION ON THE AH-1G HELICOPTER

FINAL REPORT

JOHN R. MELTON
PROJECT ENGINEER

GARY C. HALL
MAJOR, TC
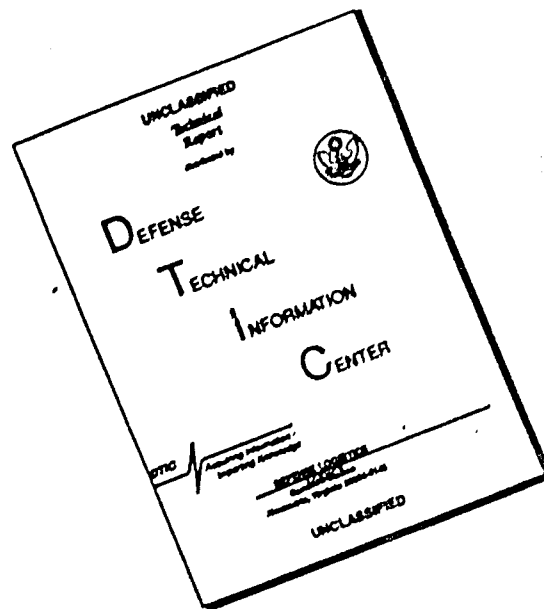US ARMY
PROJECT PILOT

MARCH 1968

US ARMY AVIATION TEST ACTIVITY
EDWARDS AIR FORCE BASE, CALIFORNIA 93523

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DEPARTMENT OF THE ARMY
US ARMY AVIATION TEST ACTIVITY
EDWARDS AIR FORCE BASE, CALIFORNIA 93523

SAVTE P

30 April 1968

SUBJECT: Change No. 1 to Final Report for Feasibility Test of
Tractor Tail Rotor Modification on the AH-1G Helicopter,
USAAVNTA Project No. 66-0C

SEE DISTRIBUTION (APPENDIX V)

The following changes are made to subject final report:

a. Page ii, reverse of front cover, change AMCPM-LH to read
AMCPM-IR in lines 5, 5, 22.

b. Document Control Data - R&D, DD Form 1473 following page 72
change:

(1) Item 10, change Hq, US Army Aviation Materiel Command,
Attn: AMSAV-0, P. O. Box 209, Main Office, St Louis, Missouri 63166
to read Hq, US Army Materiel Command, Attn: AMCPM-IR, Washington,
D. C. 20315.

(2) Item 12, change Commanding General, US Army Aviation
Materiel Command ATTN: AMSAV-0, P. O. Box 209, Main Office, St.
Louis, Missouri 63166 to read Hq, US Army Materiel Command, Attn:
AMCPM-IR, Washington, D. C. 20315.

FOR THE COMMANDER:

FRANK A. LEAVENS
CPT, AGC
Adjutant

1 Incl
as

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RDTE PROJECT NO. 1X1418D174
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ABSTRACT

A feasibility test of the tractor tail rotor modification of
the AH-1G helicopter was conducted near Fort Worth, Texas (550-
feet elevation), and Alamosa, Colorado (7535-feet elevation), dur-
ing the period 7 October to 19 October 1967. This test was con-
ducted to obtain quantitative flight test data to serve as a basis
for determining if the tractor tail rotor modification proposed by
the contractor for the AH-1G helicopter would correct the direc-
tional control problems which currently exist on the AH-1G heli-
copter with the standard tail rotor configuration. This test
revealed that in-ground-effect (IGE) low speed directional con-
trol and IGE low speed dynamic directional stability were greatly
improved by installation of the tractor tail rotor. IGE direc-
tional control limitations with the standard tail rotor installed
were encountered at approximately 8100 pounds gross weight near
sea level in previous tests. This test with the tractor tail
rotor did not reveal any IGE directional control limitations
at approximately 8940 pounds gross weight and near sea level.
The test results indicate that additional directional control
could be obtained with the tractor tail rotor, if the geometry of
the directional control system were changed to negate the adverse
effects of the stability and control augmentation system (SCAS) on
the ability to obtain full left tail rotor pitch. The highest
tail rotor horsepower encountered with large left pedal inputs to
arrest hovering turns was 250 shaft horsepower. These tests
proved that directional control deteriorated with increased gross
weight, increased density altitude or decreased rotor speed. The
test aircraft exhibited SCAS coupled pylon motion which has been a
continuing problem on the AH-1G helicopter.

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FOREWORD

During the conduct of the feasibility test of the tractor tail rotor both at Fort Worth, Texas, and Alamosa, Colorado, the helicopter and special test instrumentation were maintained under contract by Bell Helicopter Company personnel. At Fort Worth, Texas, the City of Grand Prairie, Texas, provided the test site at Grand Prairie Municipal Airport. At Alamosa, Colorado, the city of Alamosa provided the test site at Alamosa Municipal Airport. The Alamosa Volunteer Fire Department provided fire fighting equipment and personnel.

TABLE OF CONTENTS

INTRODUCTION

BACKGROUND

1. During tests conducted by the US Army Aviation Test Activity (USAAVNTA) on AH-1G helicopter S/N 66-15246 in April 1967 (ref 2, app I), it was determined that the directional control power was inadequate at some conditions within the contractor's proposed flight envelope. That test was conducted with a 20-degree tail rotor rigging. The contractor rerigged the tail rotor to 23 degrees, as a result of these findings, in an attempt to solve the directional control power problem. During tests in the 23-degree rigging configuration, the contractor encountered high power loads in the tail rotor drive train when full left directional control inputs were required. The high power loads (290 horsepower) caused considerable damage to the 42-degree and 90-degree gear boxes. The output gear train from the main transmission to the tail rotor drive was also damaged. Replacement of these components was required. Later, in an attempt to solve the problem by use of a reconfigured tail rotor blade, the same phenomenon was experienced with 270-peak horsepower to the tail rotor. This necessitated replacement of the three gear boxes again. The maximum continuous operation design point for the tail rotor is 120 horsepower. At this point the contractor determined that the maximum allowable left pedal tail rotor rigging was 19 degrees due to the tail rotor drive train power loading problem. The contractor stated that approximately 230 horsepower was the maximum attainable with a 19-degree tail rotor rigging. While pursuing a permanent solution to this problem on another test helicopter, the contractor was directed to determine the in-ground-effect (IGE) flight envelope at the 19-degree tail rotor rigging with AH-1G helicopter S/N 66-15248 for gross weights of 7500, 8500, and 9500 pounds (ref 3, app I). At the completion of this contractor test, USAAVNTA was directed by, US Army Aviation Materiel Command (USAAVCOM) to determine the areas of inadequate directional control power for 8100 pounds gross weight with a center of gravity of 194.5 inches. That test proved that there were areas of inadequate directional control at 8100 pounds, the lowest practical mission weight (ref 4 and 5, app I). As a result of these tests, various warnings and flight restrictions were imposed on the AH-1G helicopter. Since these restrictions were undesirable and the high horsepowers being experienced by the tail rotor drive train were not desirable, the contractor continued to pursue a solution. The contractor proposed that a tractor type tail rotor, described in reference 6, appendix I, be installed on the AH-1G helicopter to alleviate the problem. Limited flight tests by the contractor were conducted near sea

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level and at a high altitude test site. These tests proved to the contractor's satisfaction that the tractor tail rotor configuration was the optimum long range solution to the problem and led to the submission of Engineering Change Proposal AH-1G 350, Tractor Tail Rotor (ref 6, app I). On 25 September 1967, USAAVCOM directed that USAAVNTA conduct an evaluation of the tractor tail rotor (ref 7, app I). The test sites selected for these tests were Fort Worth, Texas (550-feet elevation) and Alamosa, Colorado (7535-feet elevation).

TEST OBJECTIVES

2. To provide quantitative flight test data to serve as a basis for determining if the tractor tail rotor modification proposed by the contractor for the AH-1G helicopter will correct the directional control problem defined in reference 2 through 5, appendix I.

3. To provide quantitative flight test data to serve as a basis for determining if Bell Helicopter Company Engineering Change Proposal AH-1G 350 should be approved.

DESCRIPTION

4. The test aircraft is the second prototype AH-1G tactical helicopter produced by Bell Helicopter Company designed specifically for the armed role. It is a tandem, two-place, high speed conventional helicopter with a two-bladed door hinge type main rotor and prototype antitorque rotor. The prototype tail rotor is located on the right side of the tail boom instead of the standard left side location. The prototype is similar to that proposed in reference 6, appendix I. The tail rotor blades are standard and set at the standard 19-degree rigging for full left pedal. A three-axis stability and control augmentation system (SCAS) is used in lieu of the stabilizer bar to improve helicopter stability and handling qualities. The test helicopter is powered by a Lycoming T53L-13 turboshaft engine rated at 1400 shaft horsepower (shp) at sea level (S.L.) standard day conditions. The power plant is derated to 1100 shp at 314 rotor rpm due to maximum torque limits of the helicopter main transmission. The distinctive features of the test helicopter are the 36-inch wide fuselage, the stub mid-wings with four external stores stations, and the integral chin turret. The armament configuration of the AH-1G is changed by varying wing stores. The flight control system is a positive mechanical type with conventional helicopter controls in the pilot's aft cockpit. The copilot/gunner's forward cockpit is provided with sidearm collective and cyclic controls. Control forces are reduced by hydraulic servo cylinders connected to the control

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system mechanical linkage and powered by dual transmission driven pumps. A synchronized elevator is used to increase static longitudinal stability and lengthen the center of gravity (C.G.) range. A force trim system is provided in the control system to give artificial control feel and positive control centering. Ausform Armor protection is provided for the crew, engine fuel control, and engine compressor section.

SCOPE OF TEST

5. The scope of this test conducted on AH-1G helicopter S/N 66-15246 at Grand Prairie Municipal Airport near Fort Worth, Texas, and Alamosa Municipal Airport, Colorado, was limited entirely to directional control testing during IGE flight. The reason for this limited scope of test was that the tractor tail rotor is a prototype system and has not been tested by the contractor throughout the flight envelope.

6. The flight restrictions which governed this test are presented in appendix IV. A safety of flight release for these flight restrictions was issued by USAAVCOM (ref 8, app I).

7. Eighteen flights were conducted during this test for a total of 12.4 test hours during an elapsed calendar time of 12 days.

8. Three types of tests were conducted: paced flight, hovering in winds, and arrestment of turn rates. The test conditions for these tests are listed in Table 1.

Table 1. Test Conditions.

TYPE OF TEST	AVG GROSS WEIGHT (lb)	AVG DENSITY ALTITUDE (ft)	ROTOR SPEED (rpm)	CENTER OF GRAVITY (in.)
Paced Flight	8030	7330	324	192.5
Paced Flight	8020	7790	324	192.5
Paced Flight	8680	7190	324	192.4
Paced Flight	8940	-150	324	193.5
Paced Flight	9510	-120	324	193.7
Hovering in wind	9130	8760	324	192.5
Arrestment of Turn Rates	9100	8750	324	192.5
Arrestment of Turn Rates	8100	7920	324	192.7

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METHODS OF TEST

9. The methods for the three tests conducted are described briefly below:

   a. Paced Flight: Paced IGE flight at various relative wind azimuths was conducted in light-steady winds (0 to 6 knots (kt)) using a calibrated pace car and wind speed and direction measuring devices in immediate proximity to the test site. Wind speed and direction were continuously and accurately recorded during all testing and correlated with each data point. A Very High Frequency (VHF) radio was installed in the test helicopter which netted with other VHF radios in the pace car and at the wind measuring site. This was necessary to correlate data points. Control positions, rates, attitudes, and tail rotor power were recorded on oscillograph at stabilized IGE flight speed increments up to the limit of control authority or 30 kt, whichever occurred first.

   b. Hovering in winds: Stabilized hovering over a spot was conducted at various wind azimuths and velocities. Control position requirements and tail rotor power were recorded as function of wind azimuth.

   c. Arrestment of Turn Rates: While hovering over a spot, right turn rates of various magnitudes were arrested at a selected helicopter heading with varying rates of pedal application. Pedal requirements and tail rotor power were recorded.

CHRONOLOGY

10. The chronology of this test program is as follows:

Test helicopter received	7 October 1967
Flight test commenced	7 October 1967
Flight test completed	19 October 1967
Test helicopter returned to contractor	19 October 1967
Draft test report submitted	31 October 1967
Final test report forwarded	March 1968

RESULTS and DISCUSSION

PACED FLIGHT

11. Paced flight at selected relative wind azimuths was the primary technique used to produce the quantitative definition of the conditions of inadequate directional control. Figures 1 through 47, appendix II, present the results of these tests. The mean (average) directional control position for the condition and the maximum excursion toward full left directional control input for each data point were determined. The magnitude of the maximum excursion from the average is some indication of the degree of instability for the condition. Figures 1, 13, 24, 34, and 43, appendix II, summarize the conditions for inadequate directional control.

12. For the purposes of this test, directional control was determined to be inadequate where the maximum excursion of directional control extended to less than 12.5 percent of full travel. Depending upon the position of the SCAS actuator at any instant, the left directional control "stop" may vary from 0 percent to 12.5 percent of full SCAS off left tail rotor pitch. This can result in something less than the 19-degree full left tail rotor pitch setting when the pedal is on the "stop". With the directional control channel of the SCAS disengaged, full left tail rotor pitch is always available.

13. Figures 2 through 12, appendix II, present the results of the tests conducted at 8030 pounds average gross weight, 324 rotor rpm, and 7330 feet density altitude. Figure 1, appendix II, summarizes the conditions for inadequate directional control (shaded areas). This figure shows that directional control is inadequate for the conditions tested for air speeds greater than 14 kt true air speed at relative wind azimuths in right sideward flight of approximately 55 degrees to 125 degrees. These test conditions were the baseline conditions for the tests conducted at the high altitude test site. From this baseline, gross weight and rotor speed were varied to determine their affects on the areas of inadequate directional control.

14. Figures 14 through 23, appendix II, present the results of the tests conducted at 8020 pounds average gross weight, 314 rotor rpm, and 7790 feet density altitude. Figure 13, appendix II, summarizes the conditions for inadequate directional control (shaded areas).

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This figure shows that directional control is inadequate in several areas for these test conditions. In right sideward flight directional control became inadequate at 8 kt. The critical speed increased to approximately 15 kt, 20 degrees to 30 degrees either side of straight right sideward flight. Two other small areas of inadequate directional control were detected in straight rearward flight and at the 230 degree to 270 degree relative wind azimuths from approximately 7-14 kt. Since all other parameters were the same as baseline (para 13) except rotor speed which was reduced to 314 rpm, it is concluded that reduced rotor speed had a significant adverse affect on directional control.

15. Figures 25 through 33, appendix II, present the results of the tests conducted at 8680 pounds average gross weight, 324 rotor rpm, and 7190 feet density altitude. Figure 24, appendix II, summarizes the conditions for inadequate directional control (shaded areas). This figure shows that directional control is inadequate in several areas for these test conditions. In right sideward flight the critical speed for inadequate directional control varied from approximately 14 kt in straight right sideward flight to approximately 8 kt at 110 degree relative wind azimuth. At relative wind azimuths from 150 to 180 degrees, a small area of inadequate directional control was noted from 6 kt to 12 kt. Since gross weight was the only parameter changed from the baseline conditions, it is apparent (comparing figure 24 with figure 2, appendix II) that an increase in gross weight adversely affects directional control.

16. Figures 35 through 42, appendix II, present the results of the tests conducted at 9510 pounds average gross weight, 324 rotor rpm, and -120 feet density altitude. Figure 34, appendix II, summarizes the conditions for inadequate directional control (shaded areas). This figure shows that a small area of inadequate directional control exists in the right sideward flight between relative wind azimuths of approximately 65 degrees and 105 degrees and true airspeeds between 15 kt and 28 kt. The effects of density altitude on directional control are indicated by this test since only a small area of inadequate control existed at near sea level conditions at 9510 pounds gross weight whereas at 9130 pounds gross weight at the high altitude test site directional control was inadequate at practically all relative wind azimuths in winds from 0 kt to 8 kt as shown in figure 48, appendix II.

17. Figures 44 through 47 present the results of the tests conducted at 8940 pounds average gross weight, 324 rotor rpm, and -150 feet density altitude. Figure 43, appendix II, summarizes the conditions for inadequate directional control (shaded areas). No areas of inadequate directional control were detected for the conditions tested at any relative wind azimuth up to true airspeeds in excess of 30 kt.

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18. The paced flight tests showed that reduced rotor speed, increased gross weight, and increased density altitude all adversely affect directional control. It is most significant that at 8010 pounds average gross weight at near sea level with the standard tail rotor, an area of inadequate directional control existed between relative wind azimuths of approximately 170 degrees and 250 degrees and true airspeed of 8 kt to 13.5 kt (para 22, ref 4, app I). At the same test site, with the tractor tail rotor, no areas of inadequate directional control exist at a gross weight of 8940 pounds. At near sea level density altitude 324 rpm, the gross weight for adequate directional control was raised from less than 8010 pounds to more than 8940 pounds with the installation of the tractor tail rotor. A comparison of the tractor tail rotor to the standard tail rotor at high density altitude was not possible due to insufficient standard tail rotor data. Density altitude, however, should have a similar adverse affect upon both the standard and tractor tail rotor. The improvement in directional control with the tractor tail rotor measured near sea level should exist at higher density altitudes.

19. A secondary effect contributing to the improvement of directional control with the tractor tail rotor was reduction of the magnitude and frequency of random external directional disturbances. With combinations of wind azimuth and velocity approaching areas of inadequate control, the standard tail rotor required rapid and sometimes large directional control excursions to maintain heading (ref 4, app I). With the tractor tail rotor, the directional disturbances were greatly reduced, and large excursions of directional control were not required.

20. Table 2 through 6, appendix II, present the peak tail rotor shaft horsepower obtained for each data point. These values are included on the figures of tail rotor pitch versus true airspeed.

HOVERING IN WINDS

21. Figure 48, appendix II, shows the tail rotor pitch required to hover at 9130 pounds gross weight, 192.5 inch C.G., 324 rpm rotor speed, and 8760 feet density altitude. During this test the wind was variable in direction and velocity so that the accuracy of the wind azimuth data was compromised. However, as figure 48, appendix II, indicates, directional control was inadequate for most wind azimuths, including low wind velocities (less than 8 kt).

22. The test conditions of figure 48, appendix II, are well within the hover performance envelope of the aircraft. This condition results in the hover ceiling of the helicopter being defined by

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available directional control rather than engine power available. This also means that the hover ceiling of the helicopter will vary greatly with both wind velocity and azimuth.

ARRESTMENT OF TURN RATES

23.   Figure 49, appendix II, shows the tail rotor shaft horsepower resulting from arresting right hovering turns. Peak horsepowers of approximately 250 shaft horsepower were recorded. These high horsepowers resulted in changes in the wear patterns on the tail rotor drive train gear boxes, but replacement was not required. Peak tail rotor shaft horsepower was found to be primarily a function of the total pedal displacement required to arrest the turn rate. Based upon the very limited amount of data available for analysis, the tail rotor power required to arrest a turn rate could not individually be defined in terms of yaw rate, yaw angular acceleration, or rate of pedal displacement. All these parameters undoubtedly affect the magnitude of the resulting tail rotor shaft horsepower, but their individual contributions could not be defined with the data available from these tests. However, there is sufficient information to show that the most significant parameter affecting peak tail rotor shaft horsepower is the size of the pedal displacement required to arrest the turn rate and not the rate of displacement. This indicates that the installation of a rate limiting device on the directional controls or the publishing of yaw rate limitations in the operator's manual is not appropriate. A note to avoid large pedal inputs which are not required in normal operation of the helicopter should be included in the pilot's handbook.

SCAS PYLON COUPLING

24.   During this test program, while flying from the contractor's facility to the test site, SCAS coupled pylon motion was encountered. The severity of the oscillation was comparable to that reported in reference 4, appendix I. The test aircraft was equipped with the pylon position sensors designed to eliminate this continuing problem. Production AH-1G aircraft are presently delivered with essentially the same pylon position sensing equipment as that installed on the test aircraft.

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CONCLUSIONS

25. Installation of the tractor tail rotor in the AH-1G helicopter results in greatly improved IGE, low speed directional control compared to the standard tail rotor (para 18).

26. The AH-1G helicopter with the tractor tail rotor installed has adequate directional control to hover in a 30-kt wind from any relative wind azimuth at a gross weight of 8940 pounds, density altitude of approximately sea level, and rotor speed of 324 rpm (para 17).

27. At a gross weight of 9510 pounds, density altitude of approximately sea level, and rotor speed of 324 rpm, inadequate directional control exists in the area of a right cross wind between relative wind azimuths of approximately 65 degrees and 105 degrees and wind velocities between 15 and 28 kt (para 16).

28. Directional control deteriorates with increased gross weight, increased density altitude, or decreased rotor speed (para 18).

29. The hover ceiling of the AH-1G is limited for some conditions by inadequate directional control rather than performance (para 22).

30. With the present directional control system geometry, it is possible to have the directional pedal fully to the left stop and not achieve maximum left tail rotor pitch. This results in a decrease in directional control available to the pilot at some conditions of SCAS actuator extension (para 12).

31. The magnitude and frequency of the random external directional distrubances observed with the standard tail rotor at combinations of wind velocity and relative wind azimuth approaching the limits of directional control are greatly reduced with the tractor tail rotor (para 19).

32. With large left pedal inputs to arrest a turn rate, peak tail rotor shaft horsepowers of approximately 250 shaft horsepower were recorded (para 23).

33. The test aircraft exhibited SCAS coupled pylon motion (para 24).

RECOMMENDATIONS

34. Further testing throughout the entire flight envelope should be conducted on the AH-1G helicopter in the tractor tail rotor configuration to insure that no penalties on performance, handling qualities, or structural integrity are suffered as a result of this modification. Particular attention should be focused on high speed maneuvering flight and those flight regimes which demand maximum right directional control requirements (para 5).

35. Consideration should be given to further improving the IGE low speed directional control power characteristics by a redesign of the directional control system geometry to allow the pilot to obtain full left tail rotor pitch with any SCAS actuator position (para 12).

36. If the tractor tail rotor is approved for production in the configuration tested, a note should be included in the pilot's handbook to disengage the directional SCAS channel if inadequate IGE directional control is encountered. This will allow the pilot to obtain full left tail rotor pitch with any SCAS actuator position (para 12).

37. Rotor speed should be maintained at 324 rpm during IGE flight (para 18).

38. Tests should be conducted to determine a final, adequate corrective measure to prevent SCAS coupled pylon motion (para 24).

APPENDIX I   REFERENCES

1.   Preliminary Draft Letter Plan of Test for, "Feasibility Test of Tractor Tail Rotor Modification on the AH-1G Helicopter," 2 October 1967.

2.   Preliminary Letter Report of Phase B, "Engineering Flight Test of AH-1G Helicopter/Hueycobra, S/N 66-15246," April 1967.

3. "Model 209 Controllability, Warning, Approach and Maneuver Envelope Documents," presented by Bell Helicopter Company on 28 July 1967.

4.   Preliminary Draft Letter Report, "Engineering Flight Test of the AH-1G Helicopter to Determine the Area of Inadequate Directional Control Power at 8100 Pounds Gross Weight," 17 August 1967.

5.   Letter from Cobra Test Team to Commanding Officer, USAAVNTA, subject: "Excessive Gear Box Wear at Standard 19-Degree Tail Rotor Rigging on AH-1G Helicopter," 10 August 1967.

6.   Bell Helicopter Company, "Engineering Change Proposal AH-1G350, Improved Anti-Torque System for the AH-1G Helicopter," 29 August 1967.

7.   Unclassified Message 9-1388 AMSAV-EF, CG, USAAVCOM to CO, USAAVNTA, Subject: "Evaluation of Tractor Tail Rotor AH-1G," 25 September 1967.

8.   Unclassified Message 500-09-11 AMSAV-EF, CG, USAAVCOM to CO, USAAVNTA, subject: "Safety of Flight Release for USAAVNTA Test of Tractor Tail Rotor on AH-1G," 30 September 1967.
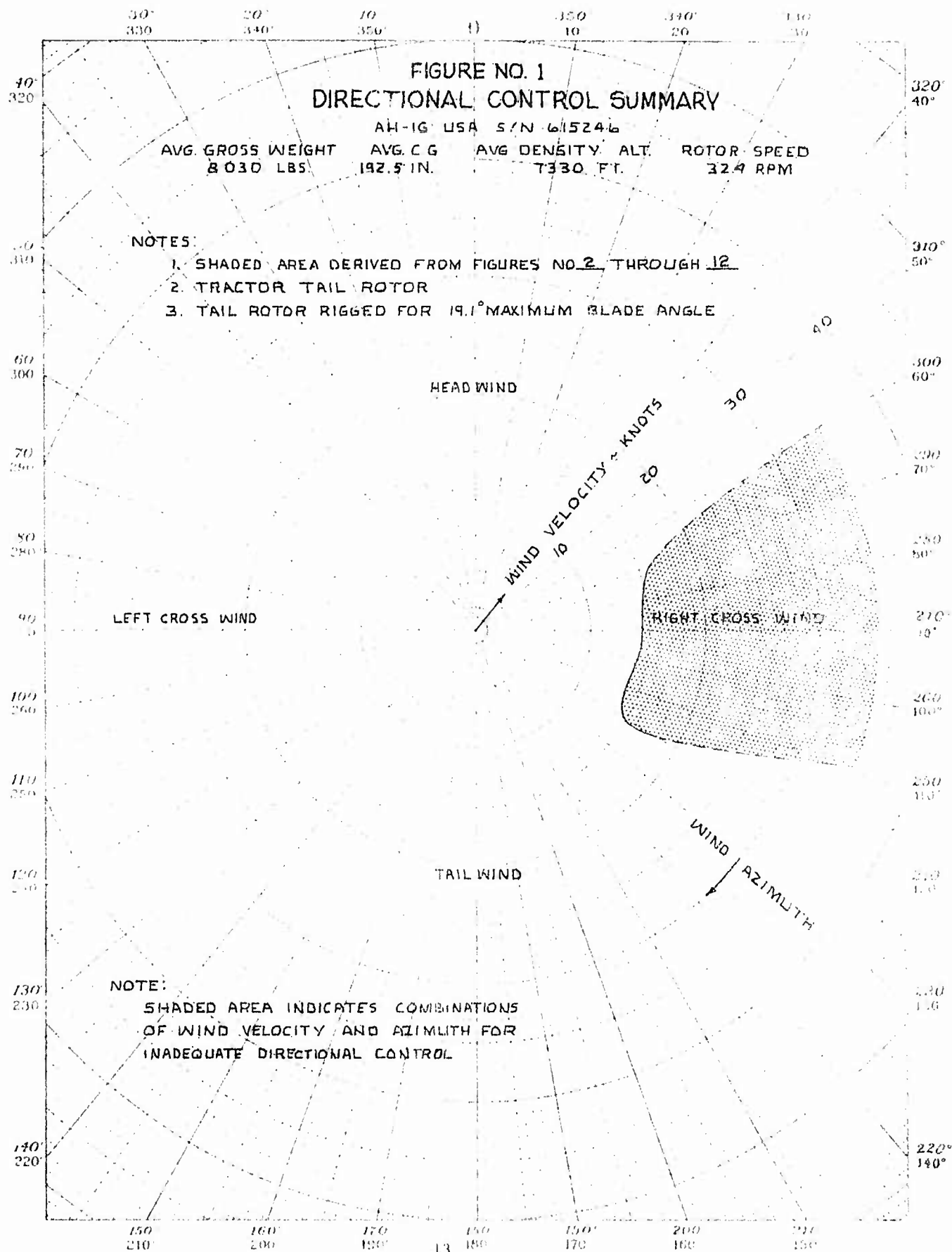
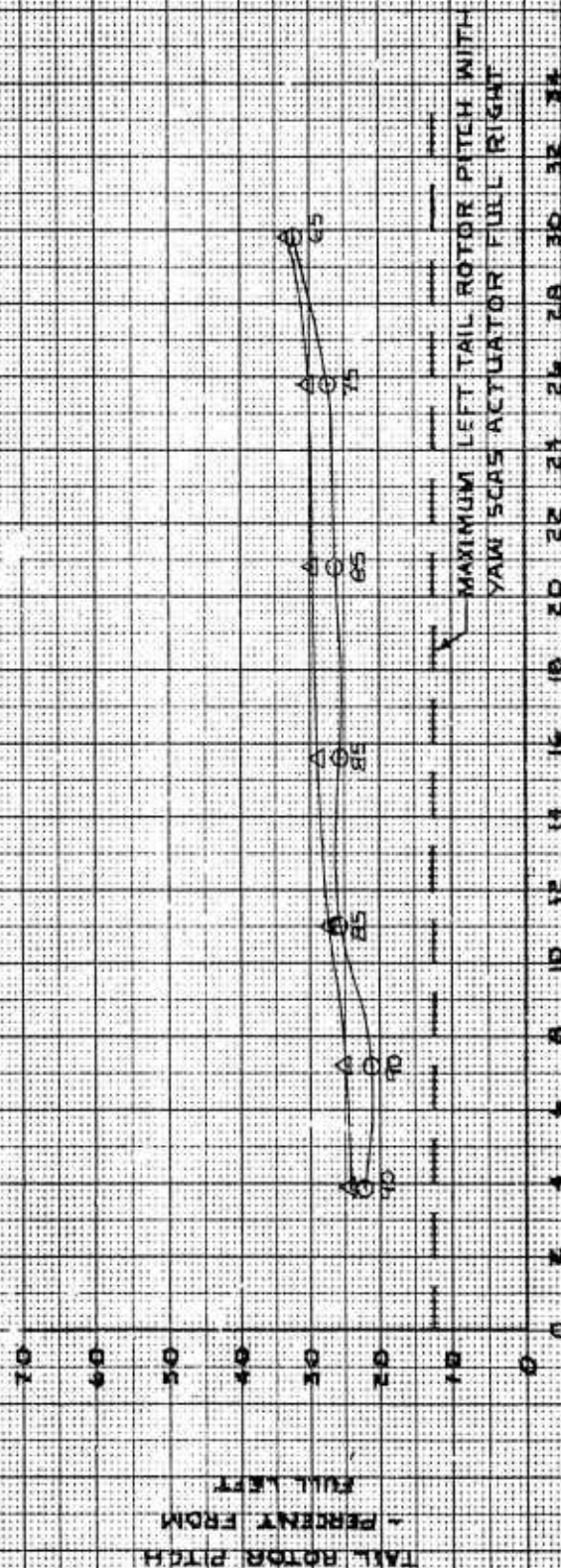# APPENDIX II   TEST DATA

FIGURE NO. 1
DIRECTIONAL CONTROL SUMMARY
AH-1G USA S/N 615246

AVG. GROSS WEIGHT	AVG. C.G.	AVG DENSITY ALT.	ROTOR SPEED
8030 LBS	192.5 IN.	7330 FT.	32.4 RPM

NOTES:
1. SHADED AREA DERIVED FROM FIGURES NO. 2 THROUGH 12
2. TRACTOR TAIL ROTOR
3. TAIL ROTOR RIGGED FOR 19.1° MAXIMUM BLADE ANGLE

HEAD WIND

WIND VELOCITY ~ KNOTS

LEFT CROSS WIND

RIGHT CROSS WIND

TAIL WIND

WIND AZIMUTH

NOTE:
SHADED AREA INDICATES COMBINATIONS
OF WIND VELOCITY AND AZIMUTH FOR
INADEQUATE DIRECTIONAL CONTROL

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Figure No. 2
TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 20°

Figure No. 3

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 40°

AH-1M USA SN 61-53198

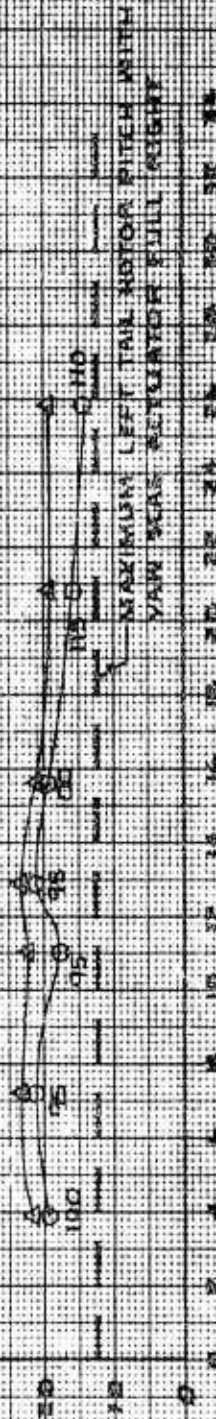|		
GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
8150 LBS	192.7 IN	7460 FT	324 RPM

NOTES: 1. TRACTOR TAIL ROTOR

2. FULL LEFT PEDAL IS 1.1° TAIL ROTOR PITCH WITH SCAS NULL

3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR

4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND

5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT

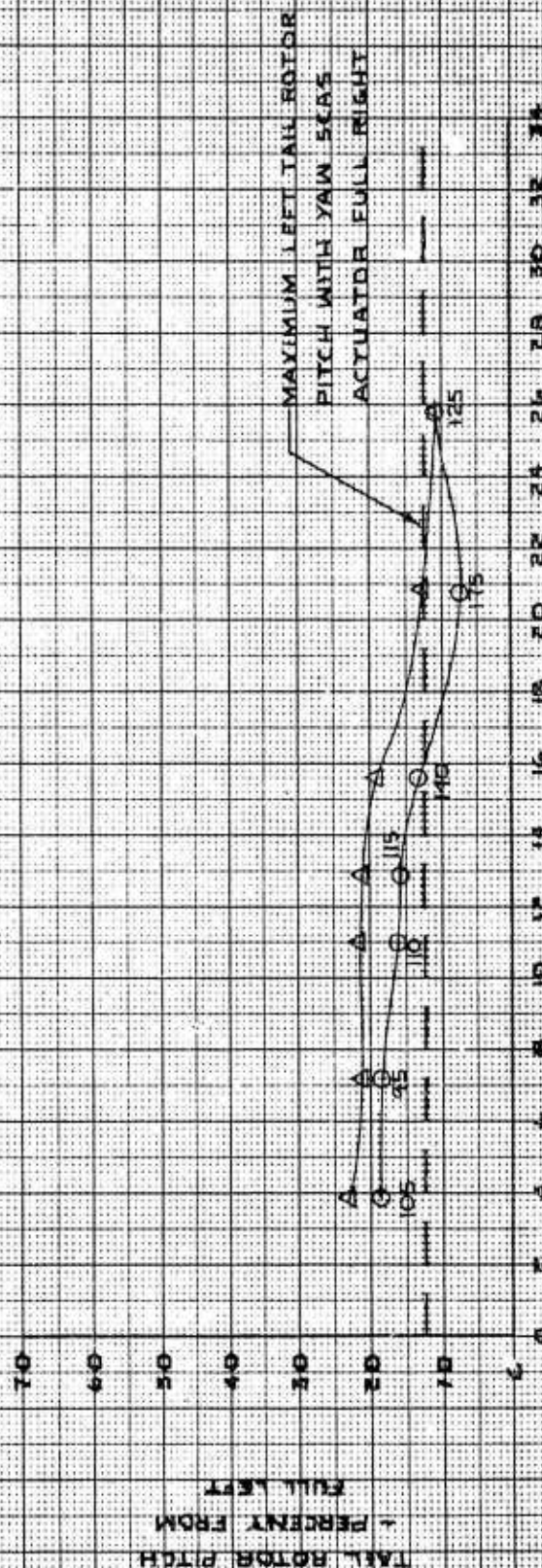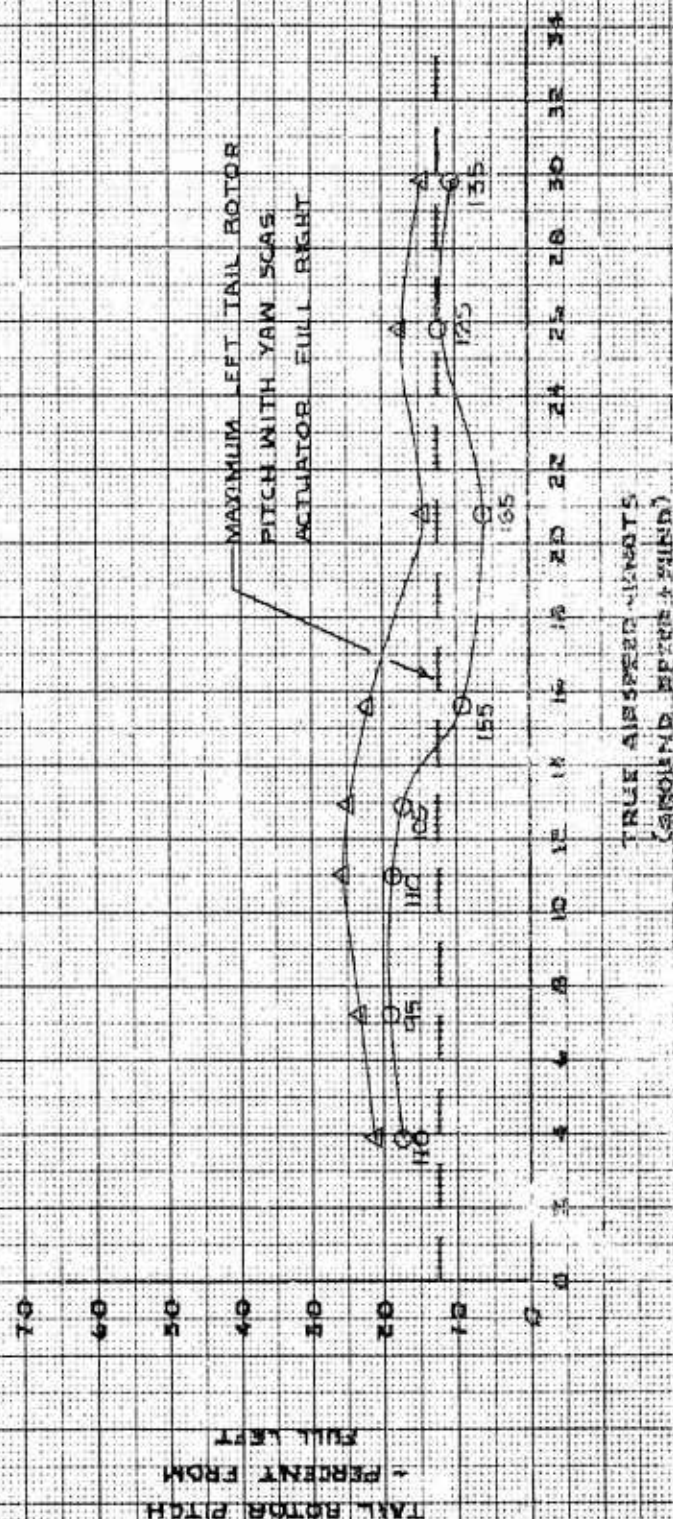△ MEAN TAIL ROTOR PITCH

○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT

MAXIMUM LEFT TAIL ROTOR PITCH WITH YAW SCAS SATURATOR FULL RIGHT

TAIL ROTOR PITCH ~ PERCENT FROM FULL LEFT

TRUE AIRSPEED ~ KNOTS (GROUND SPEED + WIND)

FIGURE No. 4

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 70°

AH-1G USA S/N 615244

GROSS WEIGHT	C.G STATION	DENSITY ALTITUDE	ROTOR SPEED
7920 LBS	192.3 IN.	7360 FT.	32.4 RPM

NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL 15.1° TAIL ROTOR PITCH WITH SCAS NULL
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSE POWERS

△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT

Figure No. 5

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 90°

AH-1S USA S/N 6152446

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
7890 LBS	192.3 IN.	7120 FT.	324 RPM

NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL (19.1° TAIL ROTOR PITCH WITH SCAS NULL)
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.

△ MEAN TAIL ROTOR PITCH
◯ MAXIMUM TAIL ROTOR PITCH USED DURING POINT

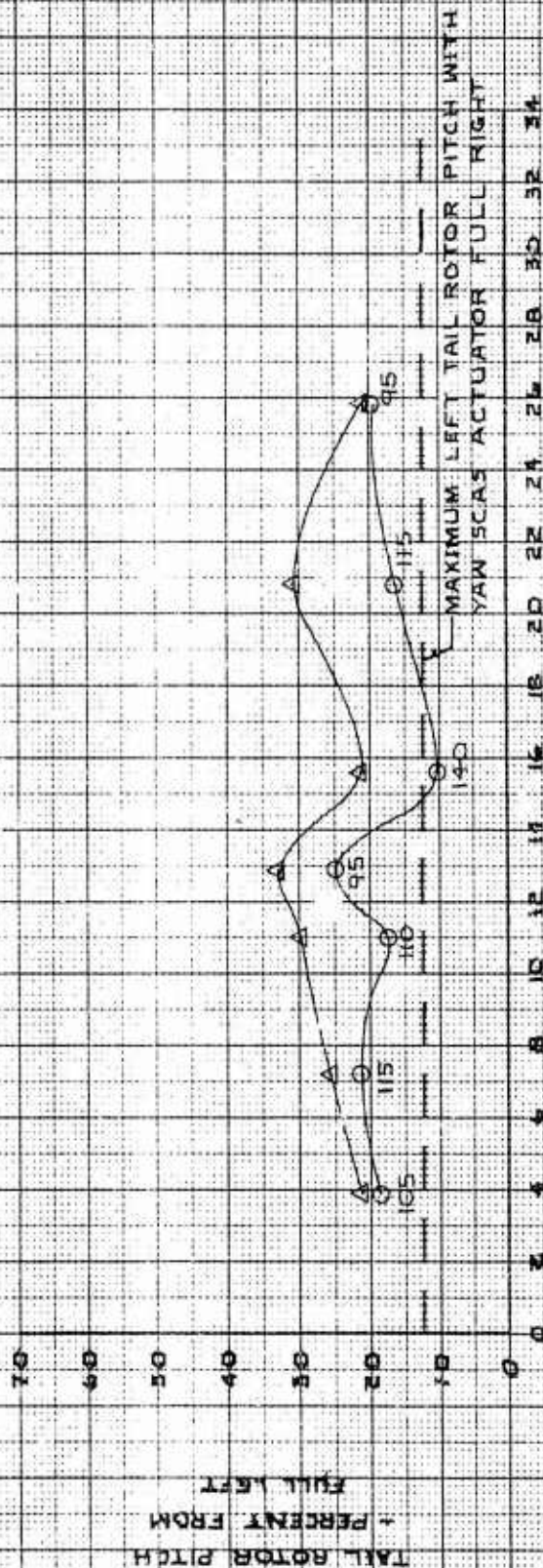MAXIMUM LEFT TAIL ROTOR PITCH WITH YAW SCAS. ACTUATOR FULL RIGHT

FIGURE No. 6
TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 120°

AH-1G USA S/N 4152443

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
7980 LBS	192.5 IN.	7360 FT.	324 RPM

NOTES: 1. TRACTOR TAIL ROTOR.
2. FULL LEFT PEDAL IS 11.9° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
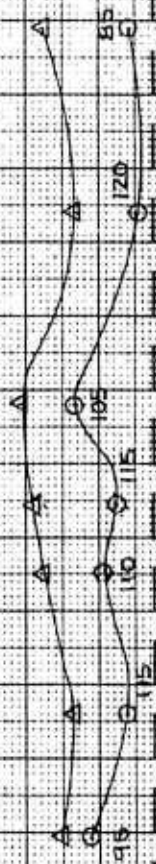5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSE POWERS RECORDED NEAR THE POINT.

△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT

FIGURE No. 7

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 140°

AH-1K USA S/N 615246

GROSS WEIGHT   C.G. STATION   DENSITY ALTITUDE   ROTOR SPEED
8050 LBS   192.6 IN.   7360 FT   324 RPM

NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL 19.1° TAIL ROTOR PITCH WITH SCAS NULL
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT

△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT

Figure No. 8

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 160°

AH-1K USA S/N 615244

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED

GROSS WEIGHT — 8125 LBS
C.G. STATION — 192.7 IN.
DENSITY ALTITUDE — 7360 FT
ROTOR SPEED — 324 RPM

NOTES:
1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL 19.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.

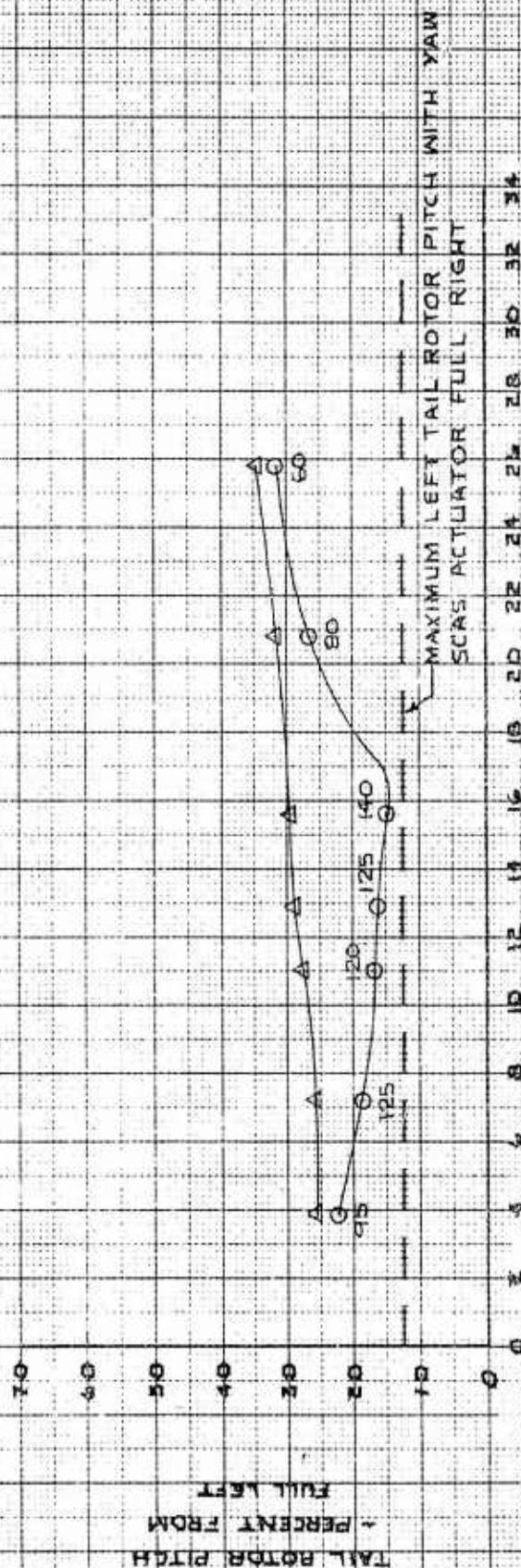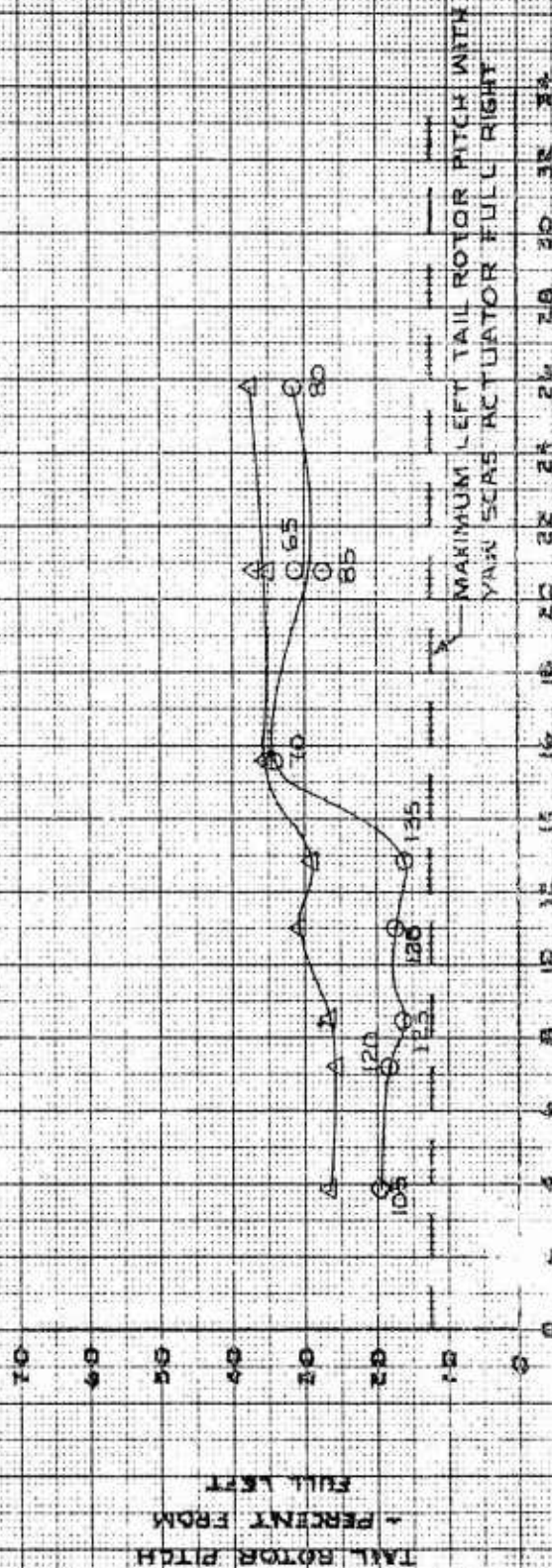△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT

MAXIMUM LEFT TAIL ROTOR PITCH WITH YAW SCAS ACTUATOR FULL RIGHT

Y-axis: TAIL ROTOR PITCH ~ PERCENT FROM FULL LEFT

X-axis: TRUE AIRSPEED ~ KNOTS (GROUND SPEED ± WIND)

Data point labels: 95, 125, 120, 125, 140, 80, 60

Figure No. 9

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 180°

AH-1G USA S/N 615246

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
8040 LBS	192.6 IN.	7120 FT.	324 RPM

NOTES: 1. TRACTOR TAIL ROTOR

2. FULL LEFT PEDAL (18.1° TAIL ROTOR PITCH WITH SCAS NULL.

3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.

4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.

5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.

△ MEAN TAIL ROTOR PITCH

○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT

MAXIMUM LEFT TAIL ROTOR PITCH WITH YAW SCAS ACTUATOR FULL RIGHT

TAIL ROTOR PITCH
→ PERCENT FROM
FULL LEFT

TRUE AIRSPEED ~ KNOTS
(GROUND SPEED ~ WIND)

FIGURE No.10

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 200°

AH-1S USA S/N 6152526

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
7870 LBS	192.3 IN.	7120 FT	324 RPM

NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL = 19.1° TAIL ROTOR PITCH WITH SCAS NULL
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.

△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT

MAXIMUM LEFT TAIL ROTOR PITCH WITH YAW SCAS ACTUATOR FULL RIGHT

TAIL ROTOR PITCH ~ PERCENT FROM FULL LEFT

TRUE AIRSPEED ~ KNOTS (GROUND SPEED + WIND)

Y-axis values: 70, 60, 50, 40, 30, 20, 10, 0

X-axis values: 0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34

Data point labels: 105, 115, 115, 115, 55, 45, 60

Figure No. 11

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 215°

AH-1S USA S/N 615246

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
8150 LBS.	192.7 IN.	7460 FT.	324 RPM

NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL ±15.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE PEAK TAIL ROTOR SHAFT HORSE POWERS

△ MEAN TAIL ROTOR PITCH
    RECORDED FOR THE POINT.
◯ MAXIMUM TAIL ROTOR PITCH
    USED DURING POINT

MAXIMUM LEFT TAIL ROTOR PITCH WITH YAW SCAS ACTUATOR FULL RIGHT

TAIL ROTOR PITCH ~ PERCENT FROM FULL LEFT

TRUE AIRSPEED ~ KNOTS (GROUND SPEED + WIND)

20 45 135 120 105 100

0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34

70 60 50 40 30 20 10 0

23

Figure No. 12

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 320°

AH-IG USA S/N 6152466

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
8050 LBS	192.6 IN.	1460 FT.	324 RPM

NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL IS 19.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR HORSEPOWERS RECORDED FOR THE POINT.

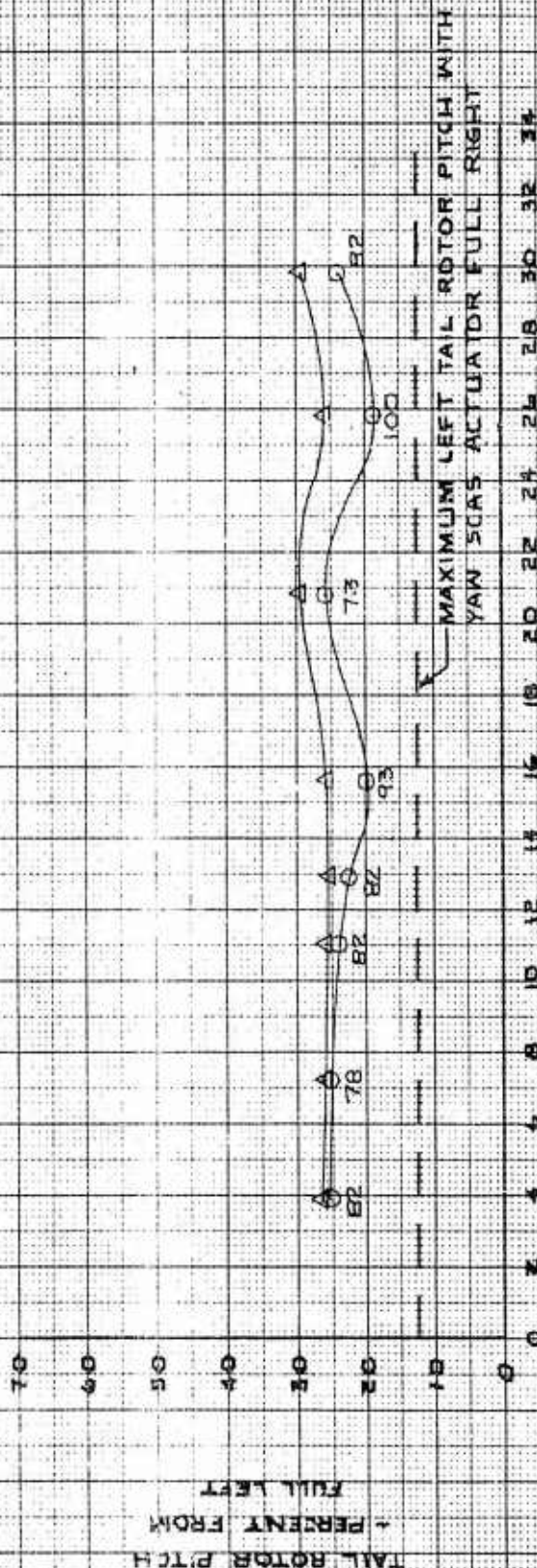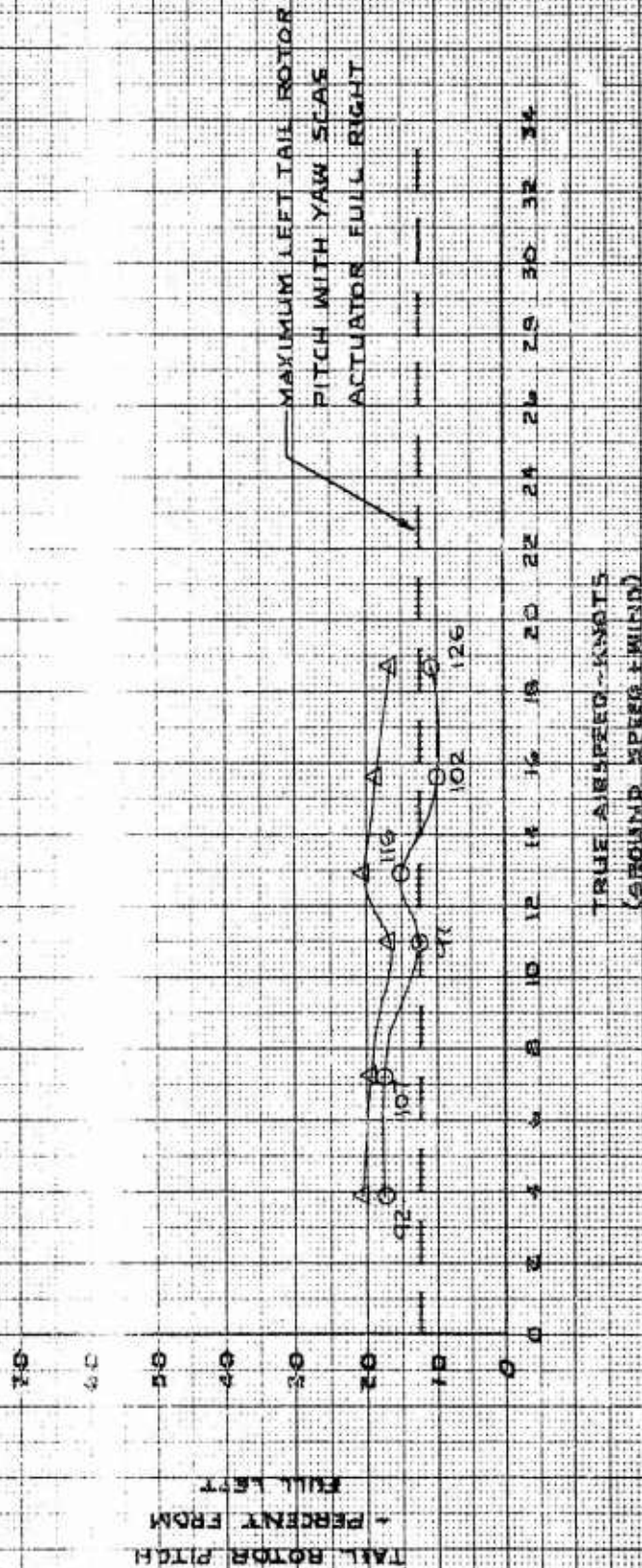△ MEAN TAIL ROTOR PITCH.
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT.

FIGURE NO. 13
DIRECTIONAL CONTROL SUMMARY
AH-1G USA S/N 615246

AVG. GROSS WEIGHT   AVG. C.G.   AVG. DENSITY ALT.   ROTOR SPEED
8020 LBS.   192.5 N   7790 FT.   314 RPM

NOTES:
1. SHADED AREA DERIVED FROM FIGURES NO. 14 THROUGH 23
2. TRACTOR TAIL ROTOR
3. TAIL ROTOR RIGGED FOR 19.1° MAXIMUM BLADE ANGLE

HEAD WIND

WIND VELOCITY - KNOTS

LEFT CROSS WIND   RIGHT CROSS WIND

WIND AZIMUTH

TAIL WIND

NOTE:
SHADED AREA INDICATES COMBINATIONS
OF WIND VELOCITY AND AZIMUTH FOR
INADEQUATE DIRECTIONAL CONTROL

Figure No. 14

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 30°

AH-1G USA S/N 615244

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
7920 LBS	192.5 IN.	7710 FT	314 RPM

NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL 119.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.

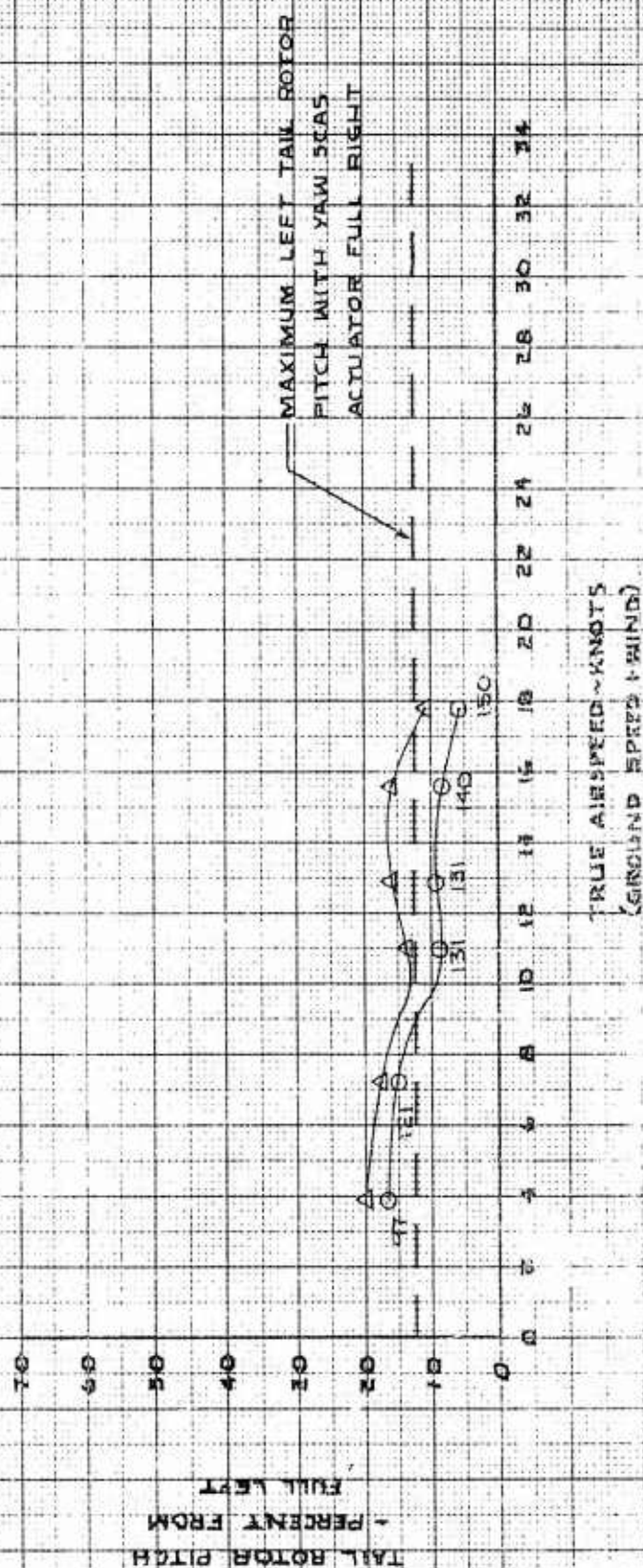△ MEAN TAIL ROTOR PITCH

○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 70°

Figure No. 15

AH-1S USA S/N 6152266

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
7890 LBS.	192.4 IN.	3970 FT.	314 RPM

NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL EQUAL 19.1° TAIL ROTOR PITCH WITH SCAS NULL
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT

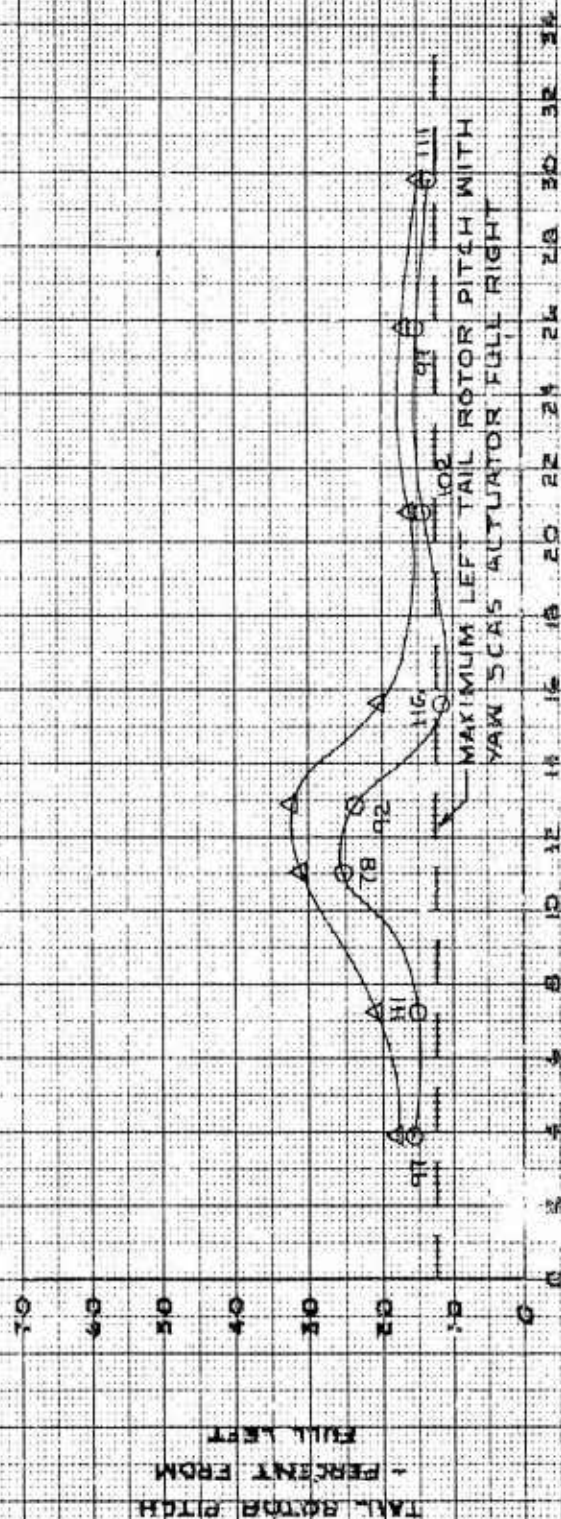△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT

MAXIMUM LEFT TAIL ROTOR PITCH WITH YAW SCAS ACTUATOR FULL RIGHT

TAIL ROTOR PITCH ~ PERCENT FROM FULL LEFT

TRUE AIRSPEED ~ KNOTS (GROUND SPEED + WIND)

Figure No. 16

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 90°

AH-1G USA S/N 6152446

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
8150 LBS	192.7 IN.	7910 FT.	314 RPM

NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL 118.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSE POWERS RECORDED FOR THE POINT.

△ MEAN TAIL ROTOR PITCH
◯ MAXIMUM TAIL ROTOR PITCH USED DURING POINT

Figure No. 17

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 120°

AH-IG USA S/N 615246

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
7680 LBS	192.4 IN.	7460 FT.	314 RPM

NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL (19.1° TAIL ROTOR PITCH WITH SCAS NULL).
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.

△ MEAN TAIL ROTOR PITCH
◯ MAXIMUM TAIL ROTOR PITCH USED DURING POINT

Figure No. 12

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 150°

AH-1G USA S/N 615244

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
8150 LBS	192.7 IN.	7710 FT	314 RPM

NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL 119.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.

△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT

MAXIMUM LEFT TAIL ROTOR PITCH WITH YAW SCAS ACTUATOR FULL RIGHT

Figure No 19

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 180°

AH-1G USA S/N 615246
C.G. STATION 192.6 IN.
DENSITY ALTITUDE 7970 FT.
ROTOR SPEED 314 RPM
GROSS WEIGHT 8040 LBS.

NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL IS 11.5° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSE POWERS RECORDED FOR THE POINT.

△ MEAN TAIL ROTOR PITCH
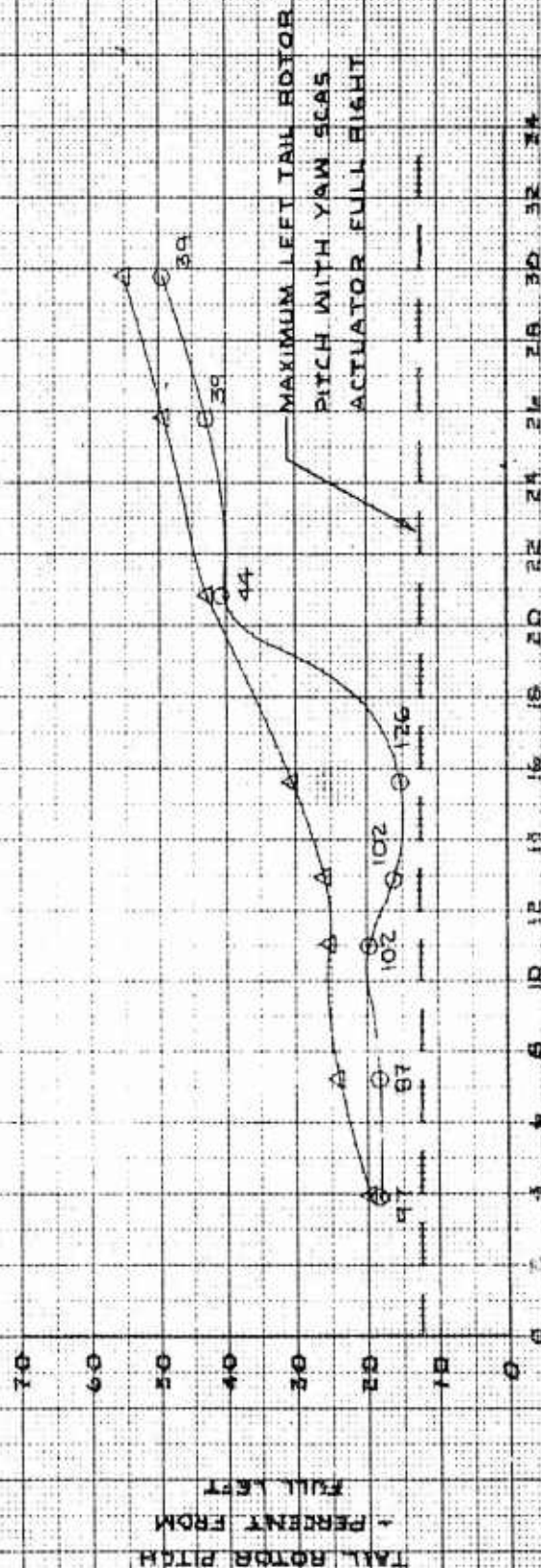○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT
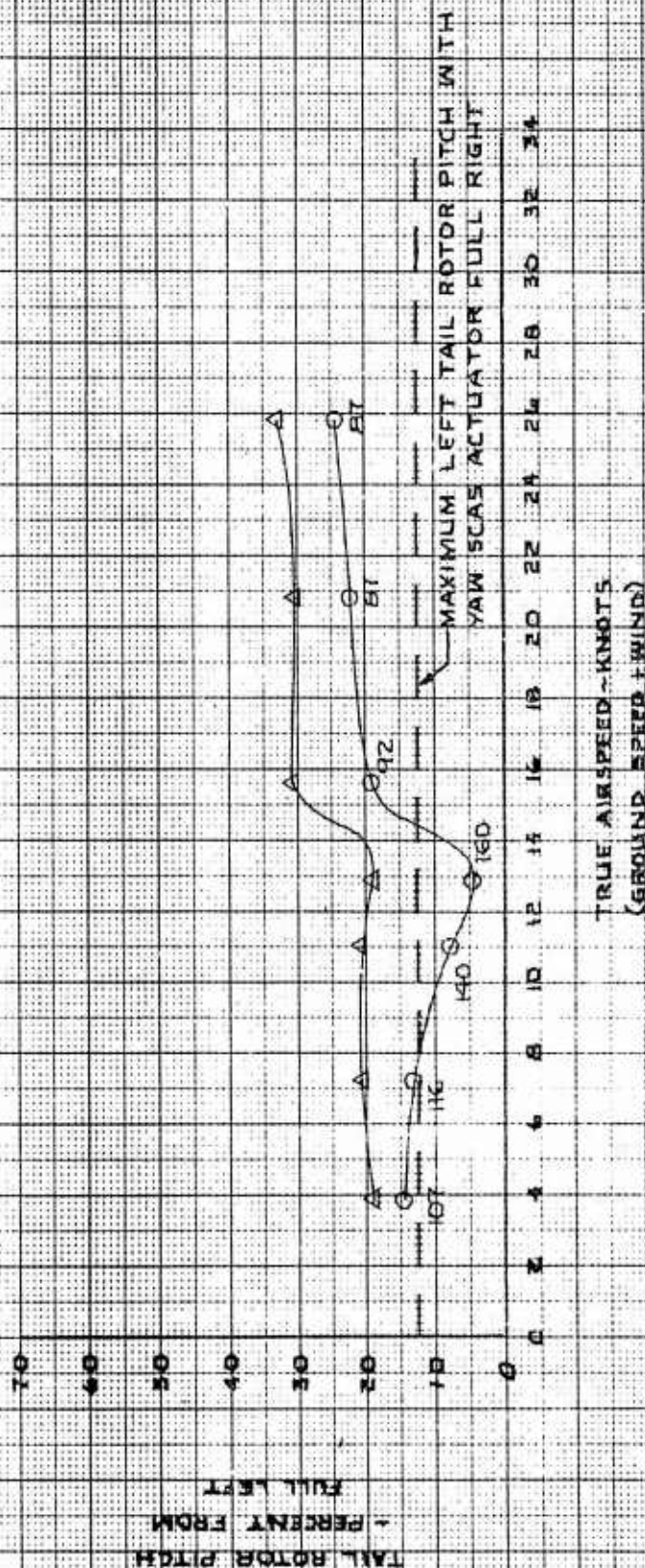
Figure No. 20
TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 210°

AH-16 USA S/N 6152146
ROTOR SPEED 314 RPM
DENSITY ALTITUDE 7110 FT.
C.G. STATION 192.6 IN.
GROSS WEIGHT 8100 LBS

NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL 19.1° TAIL ROTOR PITCH WITH SCAS NULL
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.

△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT

Figure No. 21

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 240°

AH-1R USA S/N 615244c

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
8050 LBS	192.5 IN	7710 FT	314 RPM

NOTES: 1. TRACTOR TAIL ROTOR.
2. FULL LEFT PEDAL 119.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.

△ MEAN TAIL ROTOR PITCH
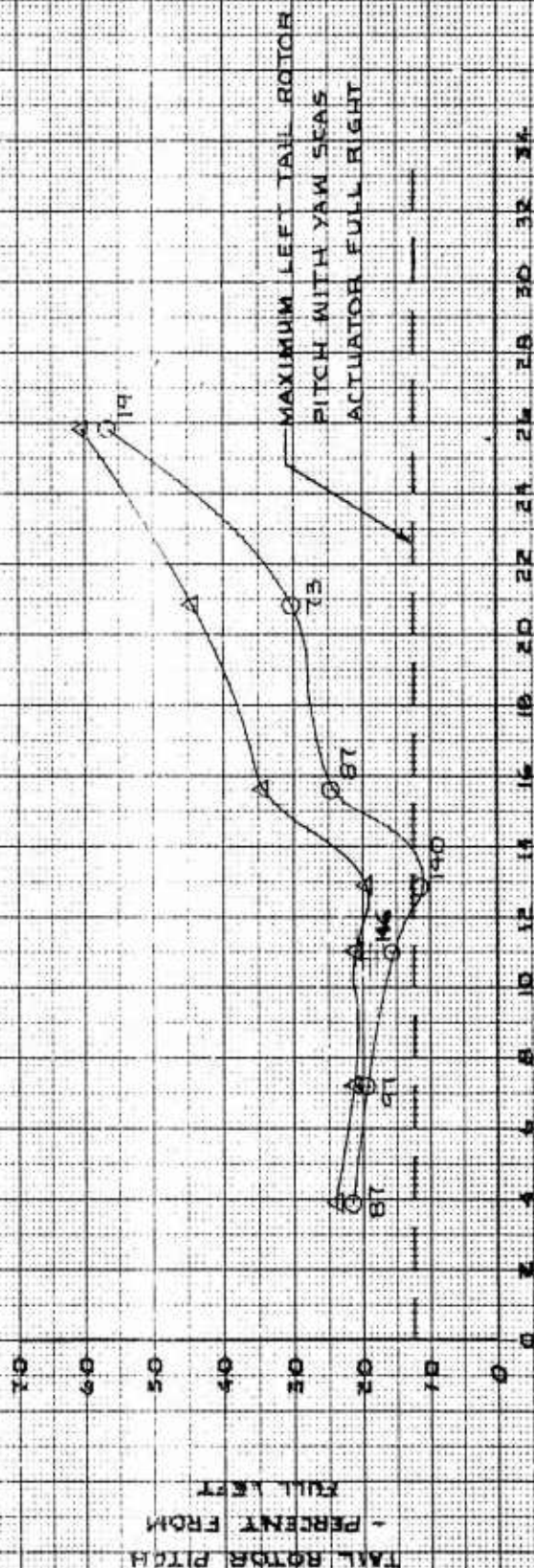○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT
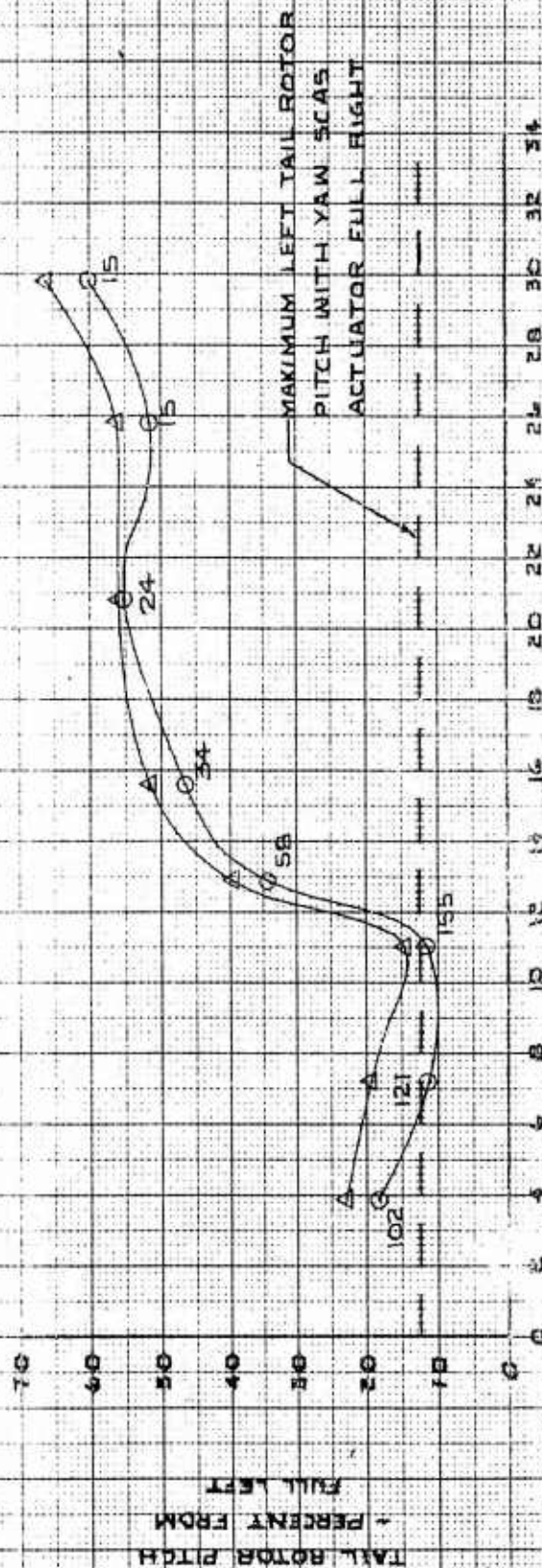
FIGURE No. 22
TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 270°

AH-1G USA S/N 6152146

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
7950 LBS	192.5 IN.	7970 FT.	314 RPM

NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL 119.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.

△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 315°

Figure No 23

AH-1R USA S/N 6152RG

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
8000 LBS	192.4 IN	7710 FT	314 RPM

NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL 119.1° TAIL ROTOR PITCH WITH SCAS NULL
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT

△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT

MAXIMUM LEFT TAIL ROTOR
PITCH WITH YAW SCAS
ACTUATOR FULL RIGHT

TAIL ROTOR PITCH ~ PERCENT FROM FULL LEFT

TRUE AIRSPEED ~ KNOTS
(GROUND SPEED + WIND)

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FIGURE NO. 24
DIRECTIONAL CONTROL SUMMARY
AH-IG U.S.A. S/N 615246

AVG. GROSS WEIGHT	AVG. C.G	AVG DENSITY ALT.	ROTOR SPEED
8680 LBS	192.41 IN.	7190 FT.	324 RPM

NOTES:
1. SHADED AREA DERIVED FROM FIGURE NO 25 THROUGH 33
2. TRACTOR TAIL ROTOR
3. TAIL ROTOR RIGGED FOR 19.1° MAXIMUM BLADE ANGLE

HEAD WIND

LEFT CROSS WIND

RIGHT CROSS WIND

TAIL WIND

WIND VELOCITY ~ KNOTS

WIND AZIMUTH

NOTE:
SHADED AREA INDICATES COMBINATIONS
OF WIND VELOCITY AND AZIMUTH FOR
INADEQUATE DIRECTIONAL CONTROL

36

Figure No. 25

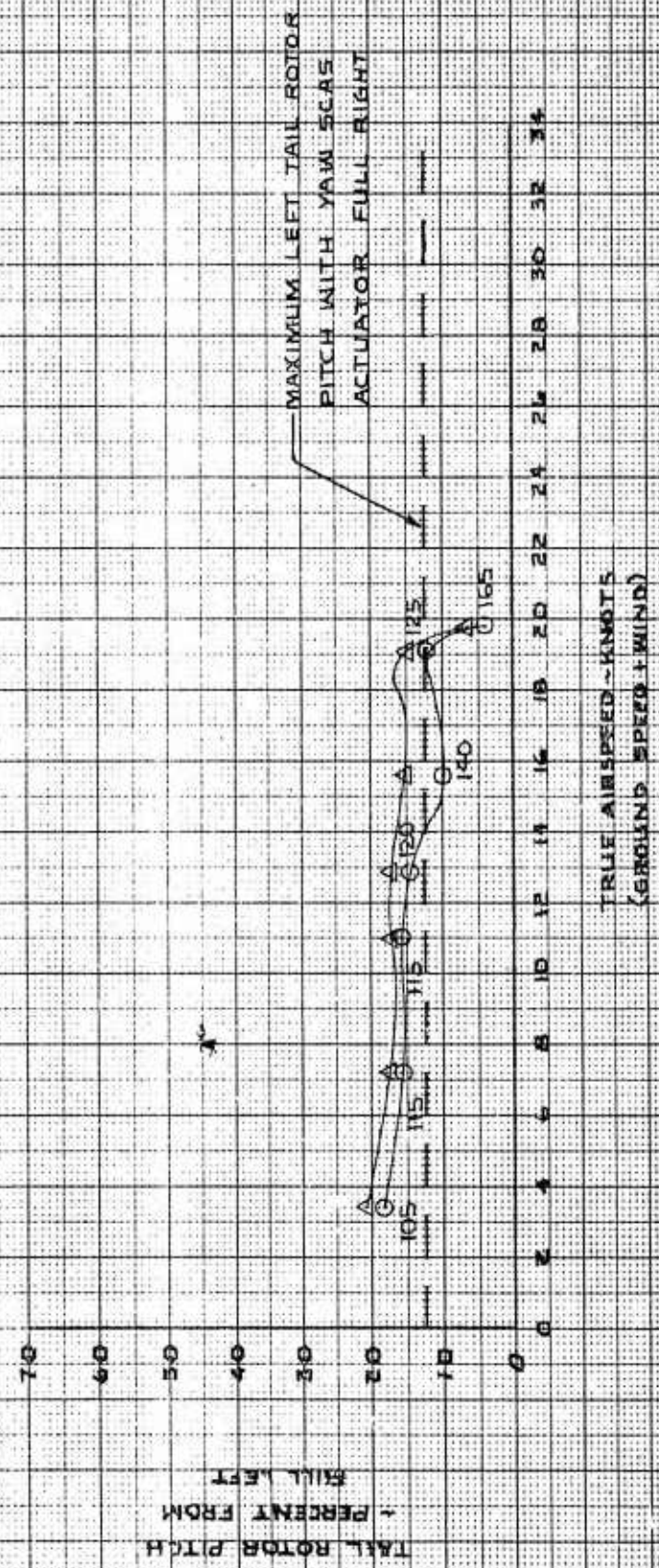TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 35°
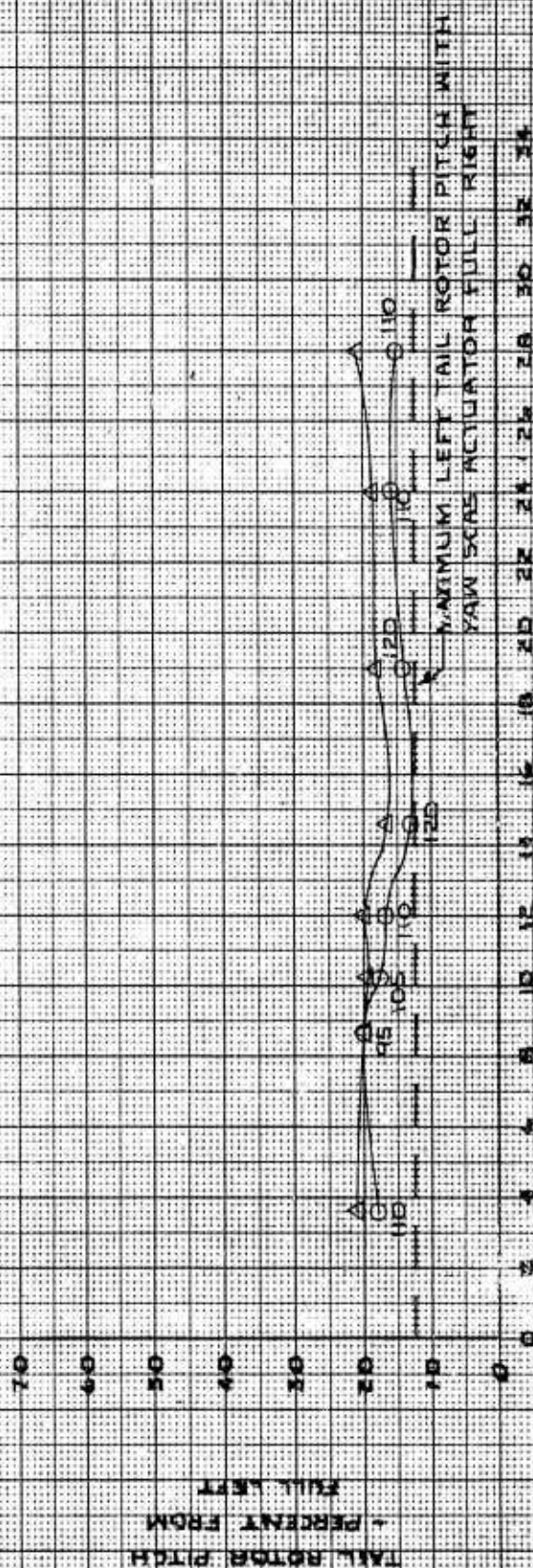
Figure No. 26
TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 65°

AH-1G USA S/N 6152146

GROSS WEIGHT: 8700 LBS
C.G. STATION: 172.5 IN.
DENSITY ALTITUDE: 7260 FT.
ROTOR SPEED: 324 RPM

NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL 118.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.

△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT

MAXIMUM LEFT TAIL ROTOR PITCH WITH YAW SCAS ACTUATOR FULL RIGHT

Figure No. 27

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 90°

AH-1G USA S/N 415246

Figure No. 28.
TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 110°

Figure No. 29

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 140°

AH-16 USA S/N 6157-6

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
8780 LBS	192.5 IN.	7600 FT.	324 RPM

NOTES:
1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL 119.1° TAIL ROTOR PITCH WITH SCAS NULL
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT

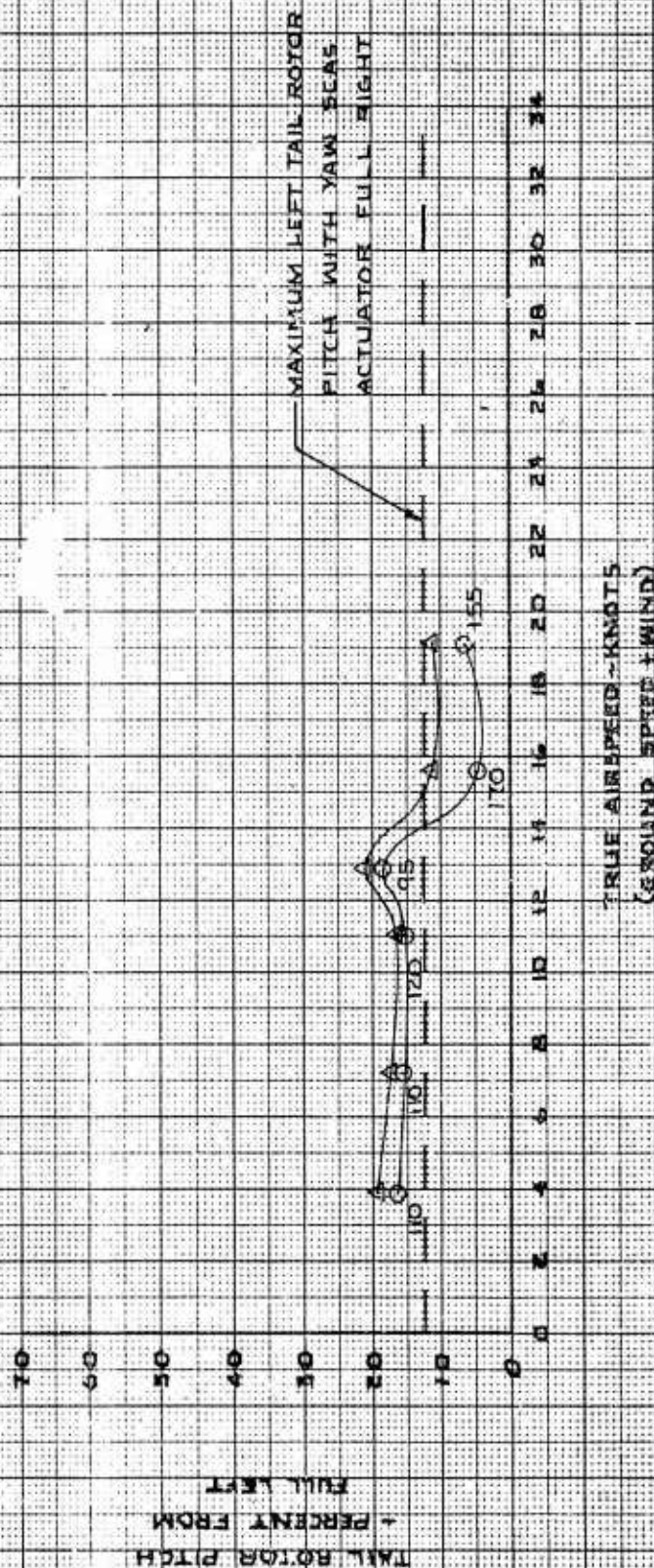△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT

MAXIMUM LEFT TAIL ROTOR PITCH WITH YAW SCAS ACTUATOR FULL RIGHT

TRUE AIRSPEED ~ KNOTS
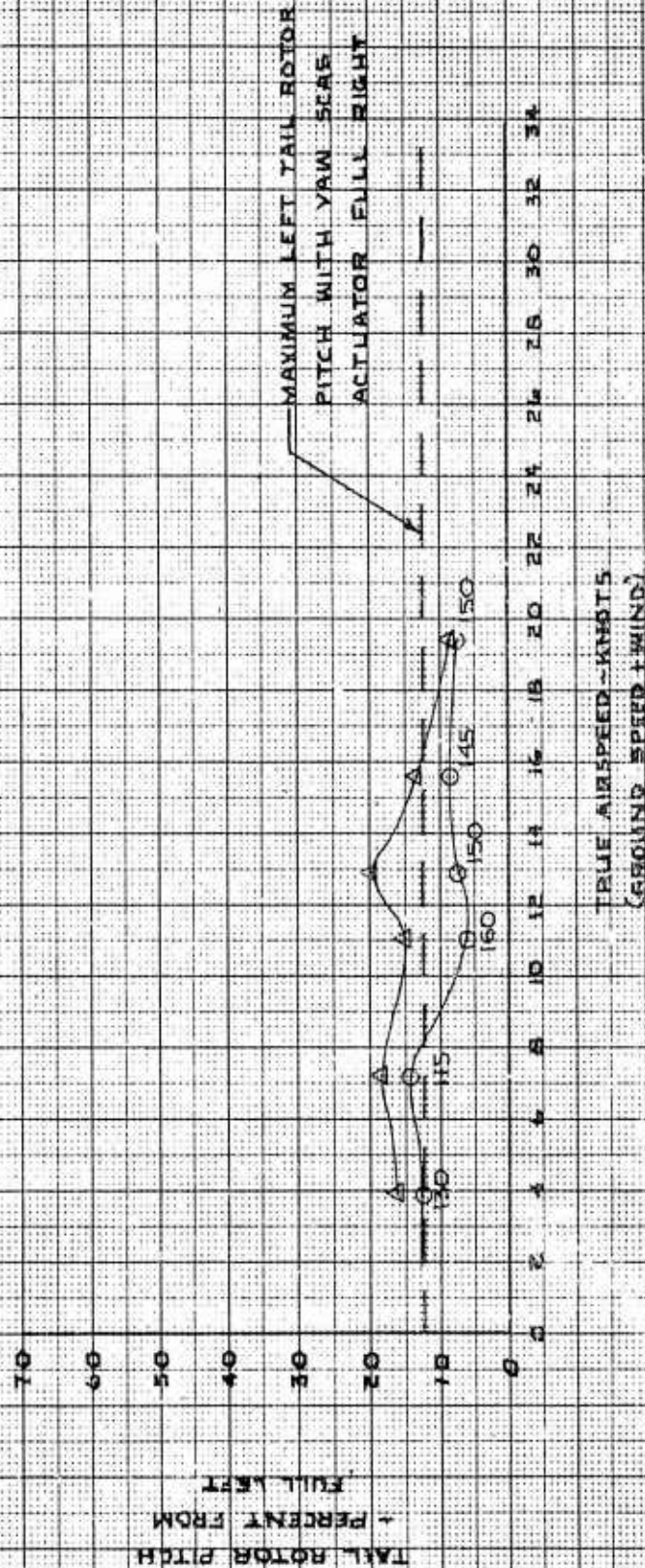(GROUND SPEED + WIND)

TAIL ROTOR PITCH ~ PERCENT FROM FULL LEFT

Figure No. 30

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 160°

AH-1G USA S/N 6152146

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
8610 LBS.	172.4 IN.	7260 FT.	324 RPM

NOTES: 1. TRACTOR TAIL ROTOR

2. FULL LEFT PEDAL ID.I° TAIL ROTOR PITCH WITH SCAS NULL.

3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.

4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF
GROUND SPEED AND WIND.

5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS
RECORDED FOR THE POINT

△ MEAN TAIL ROTOR PITCH

○ MAXIMUM TAIL ROTOR PITCH
USED DURING POINT

FIGURE No 3)

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 180°

AH-1S USA S/N 6152466

GROSS WEIGHT	CG STATION	DENSITY ALTITUDE	ROTOR SPEED
8150 LBS	192.4 IN	6810 FT	324 RPM

NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL (19.1° TAIL ROTOR PITCH) WITH SCAS NULL
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS

△ MEAN TAIL ROTOR PITCH RECORDED FOR THIS POINT
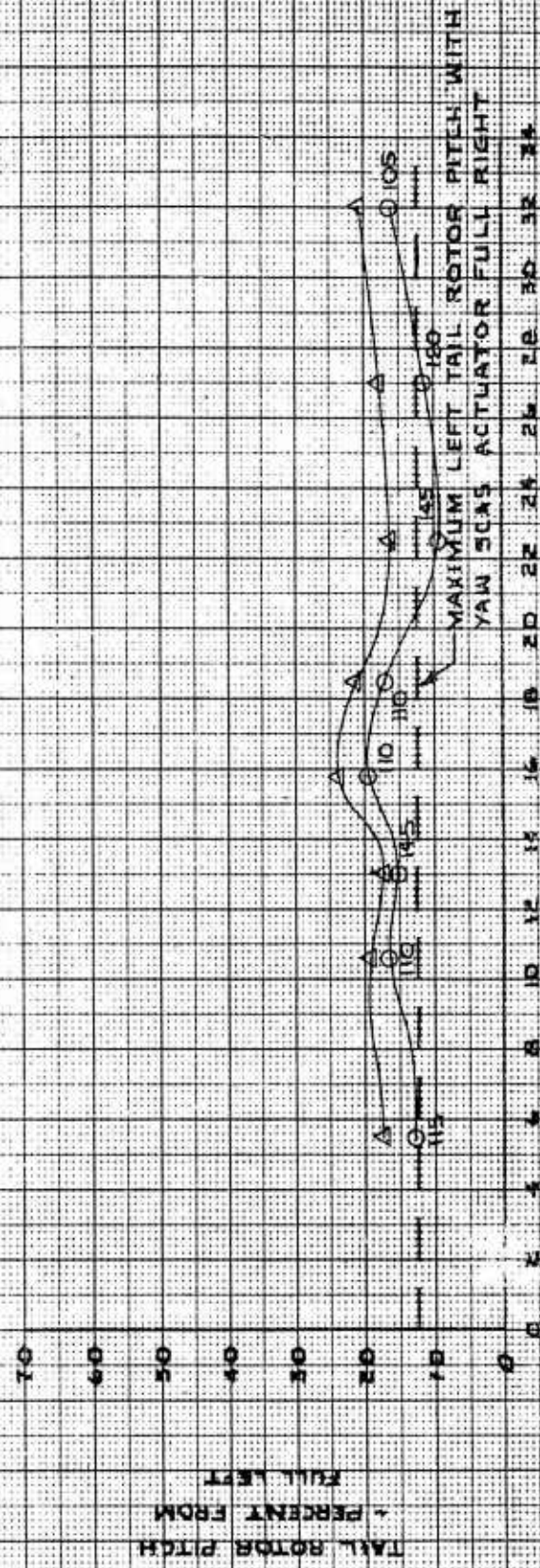○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT

MAXIMUM LEFT TAIL ROTOR PITCH WITH YAW SCAS ACTUATOR FULL RIGHT

TAIL ROTOR PITCH ~ PERCENT FROM FULL LEFT

TRUE AIRSPEED ~ KNOTS (GROUND SPEED + WIND)

Figure No. 32

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 200°

Figure No. 33

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 280°

FIGURE NO. 34
DIRECTIONAL CONTROL SUMMARY
AH-1G USA S/N 45246

AVG. GROSS WEIGHT	AVG. CG.	AVG. DENSITY ALT	ROTOR SPEED
9510 LBS	193.7 IN	120 FT.	324 RPM

NOTES:
1. SHADED AREA DERIVED FROM FIGURE NO. 35 THROUGH 42
2. TRACTOR TAIL ROTOR
3. TAIL ROTOR RIGGED FOR 19.1° MAXIMUM BLADE ANGLE

HEAD WIND

WIND VELOCITY ~ KNOTS

LEFT CROSS WIND

WIND AZIMUTH

TAIL WIND

NOTE:
SHADED AREA INDICATES COMBINATIONS
OF WIND VELOCITY AND AZIMUTH FOR
INADEQUATE DIRECTIONAL CONTROL

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Figure No. 35

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 70°

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Figure No. 36

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 90°

Figure No. 37

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 110°

AH-1G USA S/N 6152746
GROSS WEIGHT   C.G. STATION   DENSITY ALTITUDE   ROTOR SPEED
9490 LBS   195.8 IN.   290 FT.   324 RPM

NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL IS 0° TAIL ROTOR PITCH WITH SCAS NULL
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT

△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT

MAXIMUM LEFT TAIL ROTOR PITCH WITH YAW SCAS ACTUATOR FULL RIGHT
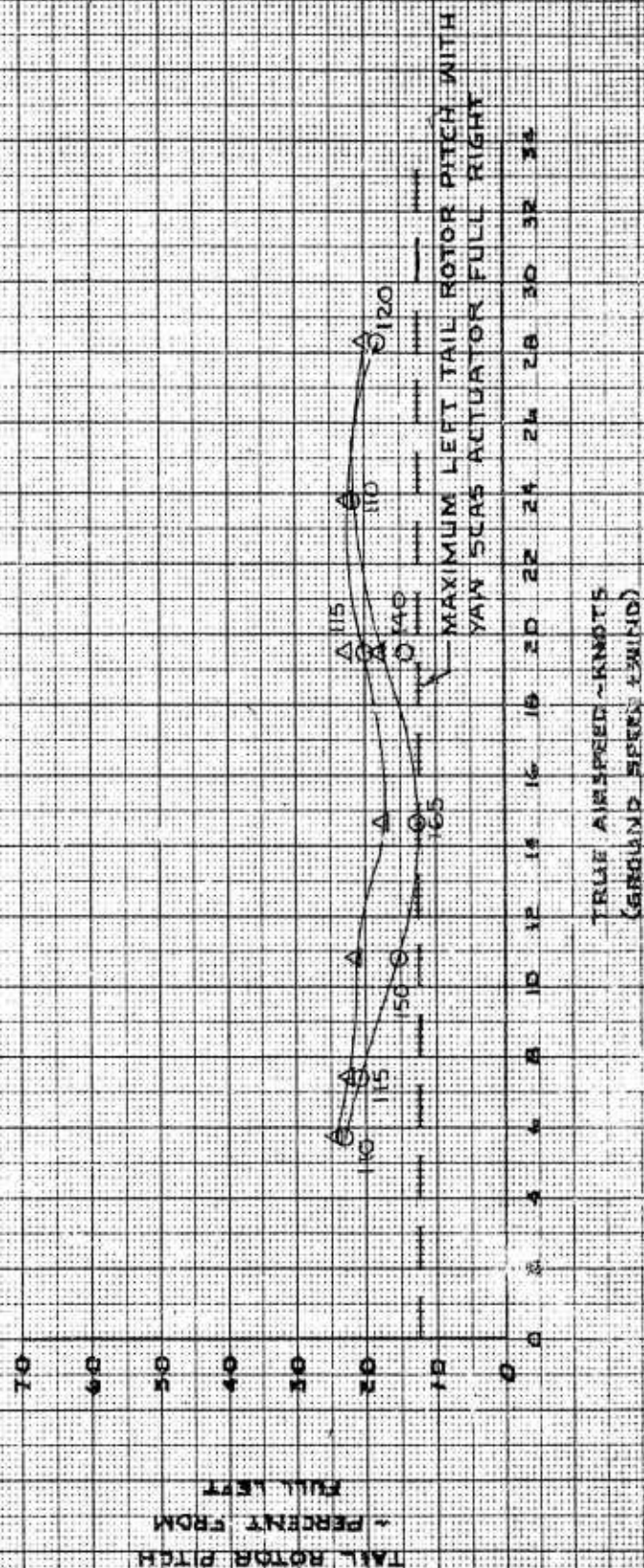
Figure No. 38

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 130°

AH-16 USA S/N 6152746

GROSS WEIGHT: 9460 LBS. C.G. STATION: 193.5 IN. DENSITY ALTITUDE: 60 FT. ROTOR SPEED: 324 RPM

NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL ±19.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT THE DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.

△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT
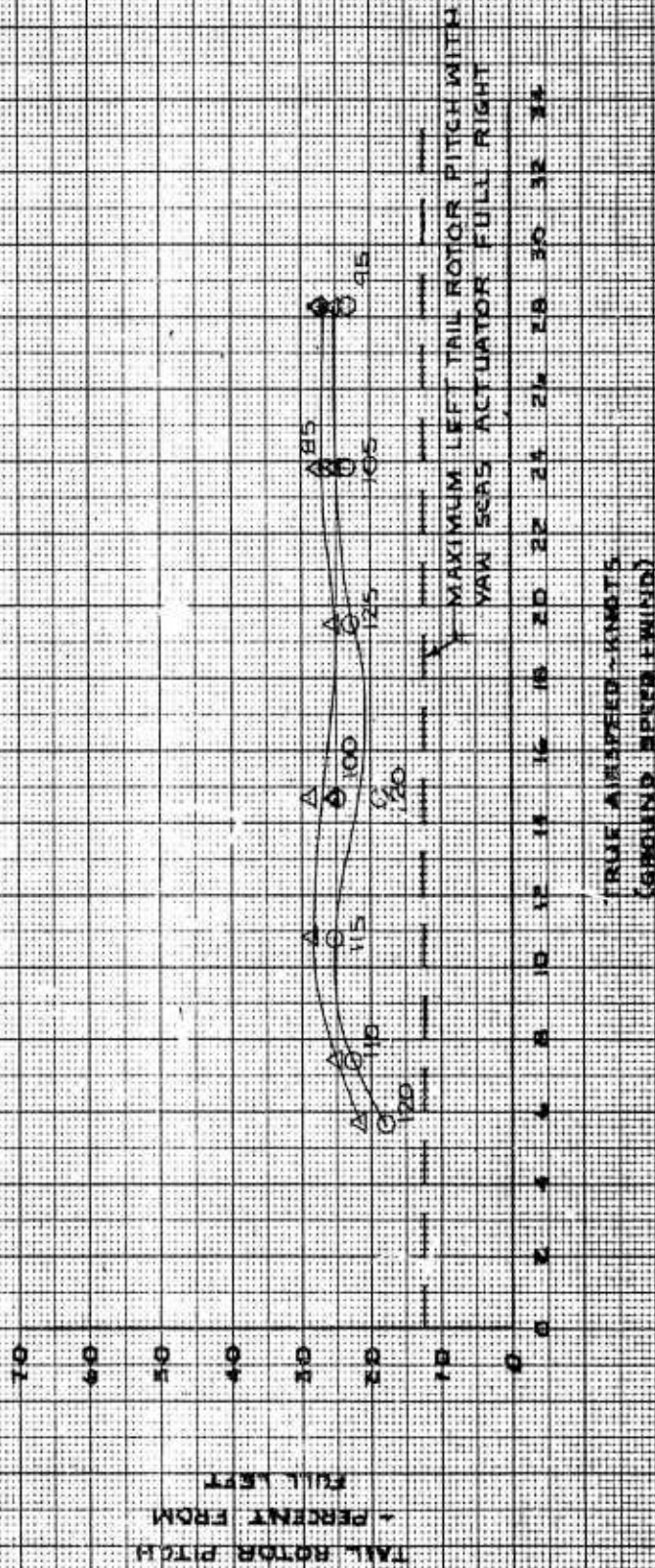
Figure No. 39

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 160°

AH-1G USA SN 413746

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
9660 LBS	193.8 IN.	60 FT	324 RPM

NOTES 1/. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL (19.1° TAIL ROTOR PITCH) WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSE POWERS RECORDED FOR THE POINT.

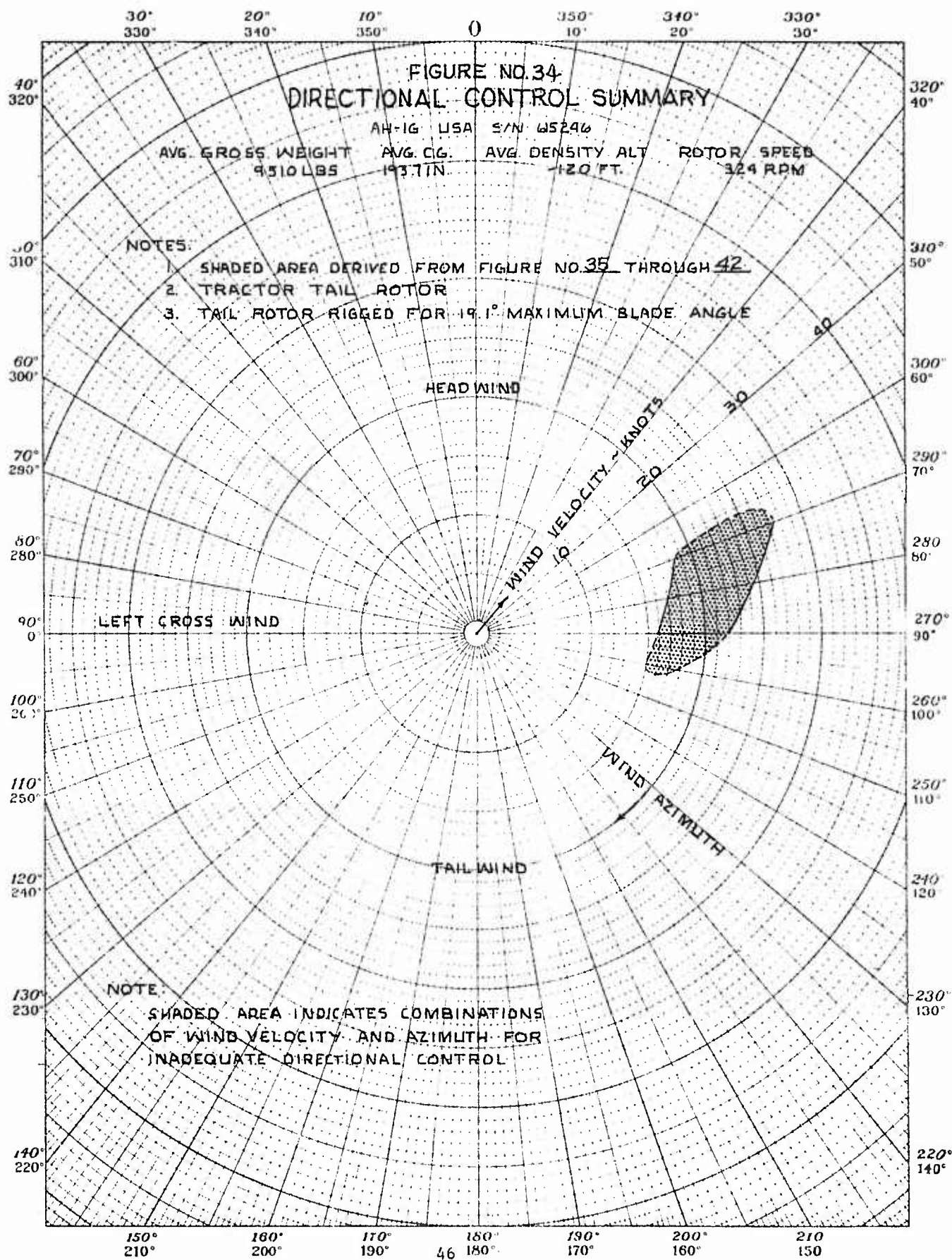△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT

Figure No. 40

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 180°

AH-1G USA S/N 6152446

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
9420 LBS	193.7 IN.	-290 FT	324 RPM

NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL IS 0° TAIL ROTOR PITCH WITH SCAS NULL
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS

△ MEAN TAIL ROTOR PITCH RECORDED FOR THE POINT
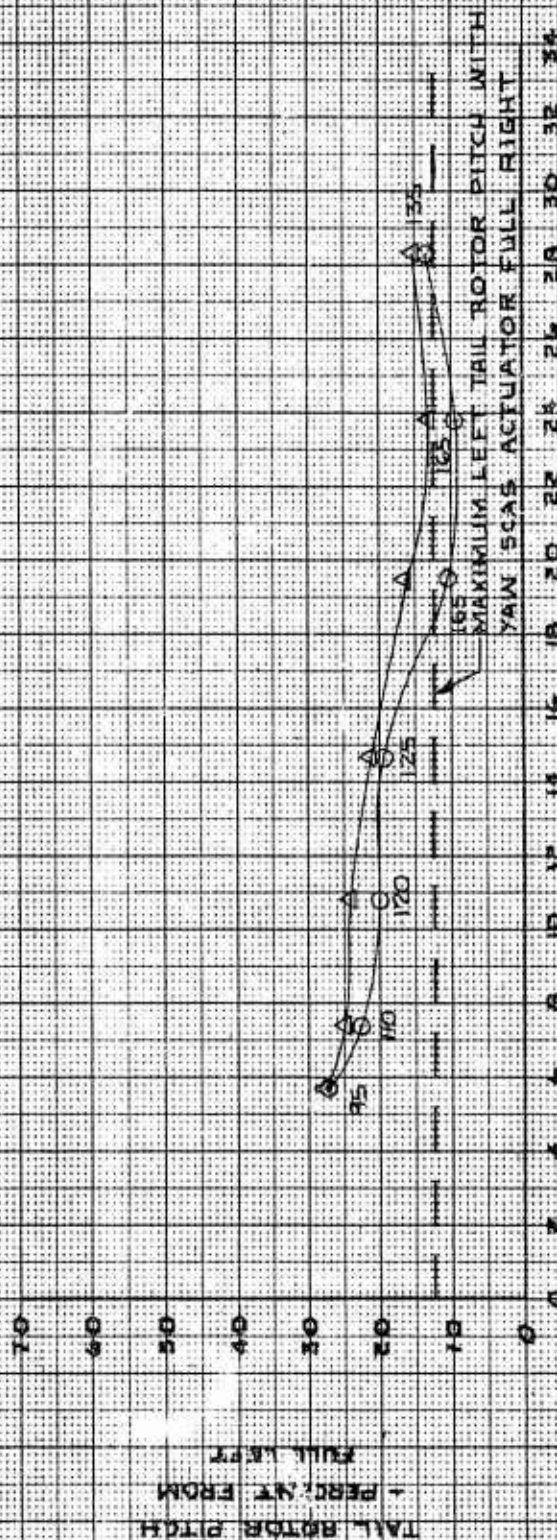○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT

FIGURE No. 41
TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 200°

AH-1G USA S/N 6152446

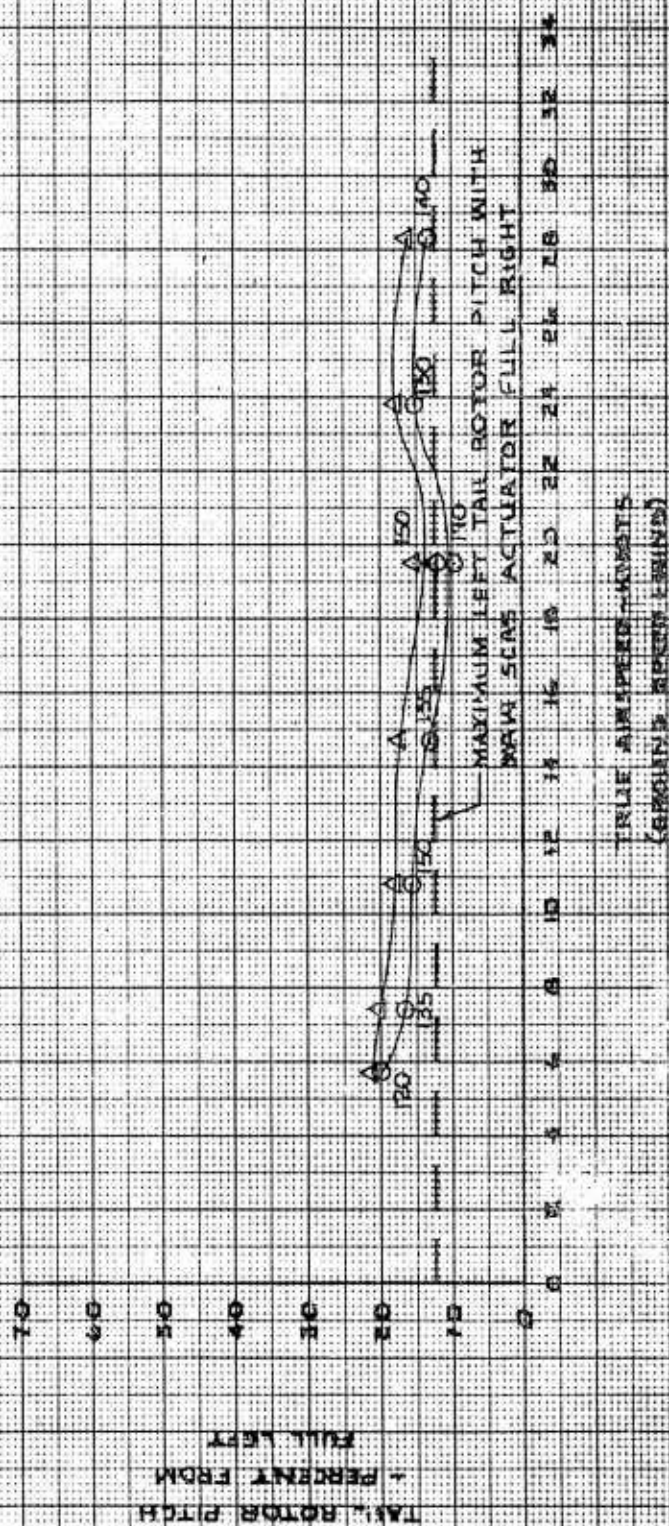| GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
9600 LBS	193.7 IN.	60 FT.	324 RPM

NOTES: 1. TRACTOR TAIL ROTOR

2. FULL LEFT PEDAL IS 11.5° TAIL ROTOR PITCH WITH SCAS NULL.

3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.

4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.

5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.

△ MEAN TAIL ROTOR PITCH

○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT

Figure No. 42

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 270°

AH-1G USA S/N 615244

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
9530 LBS	193.6 IN.	60 FT	324 RPM

NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL IS 19.1° TAIL ROTOR PITCH WITH SCAS NULL
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT

△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT

FIGURE NO. 43
DIRECTIONAL CONTROL SUMMARY
AH-1G USA S/N 015246

AVG. GROSS WEIGHT	AVG. C.G.	AVG. DENSITY ALT.	ROTOR SPEED
8940 LBS	193.5 IN	-150 FT	324 RPM

NOTES:
1. SHADED AREA DERIVED FROM FIGURES NO. 44 THROUGH 47
2. TRACTOR TAIL ROTOR
3. TAIL ROTOR RIGGED FOR 19.1 MAXIMUM BLADE ANGLE

HEAD WIND

WIND VELOCITY ~ KNOTS

LEFT CROSS WIND

RIGHT CROSS WIND

WIND AZIMUTH

TAIL WIND

NOTE:
SHADED AREA INDICATES COMBINATIONS
OF WIND VELOCITY AND AZIMUTH FOR
INADEQUATE DIRECTIONAL CONTROL

55
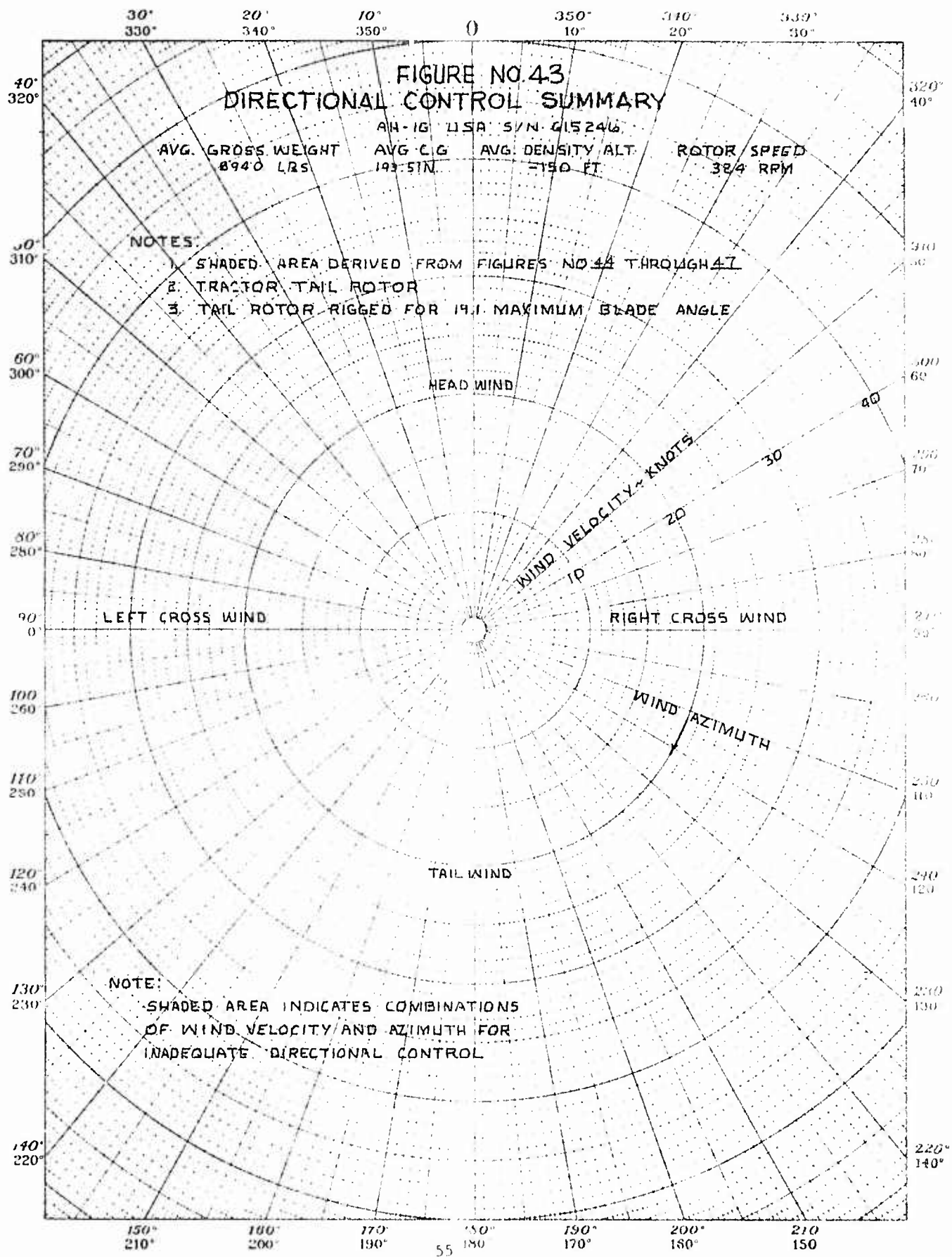
Figure No. 44

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 50°

AH-1G USA S/N 6152446

GROSS WEIGHT	CG STATION	DENSITY ALTITUDE	ROTOR SPEED
8820 LBS	193.4 IN.	1150 FT.	32.4 RPM

NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL 119.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.

△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT

Figure No. 45

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 70°

AH-1G USA SN 415244

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
8980 LBS	193.6 IN.	-150 FT.	324 RPM

NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL IS 0° TAIL ROTOR PITCH WITH SCAS NULL
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT

△ MEAN TAIL ROTOR PITCH
○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT

MAXIMUM LEFT TAIL ROTOR PITCH WITH YAW SCAS ACTUATOR FULL RIGHT

TAIL ROTOR PITCH ~ PERCENT FROM FULL LEFT
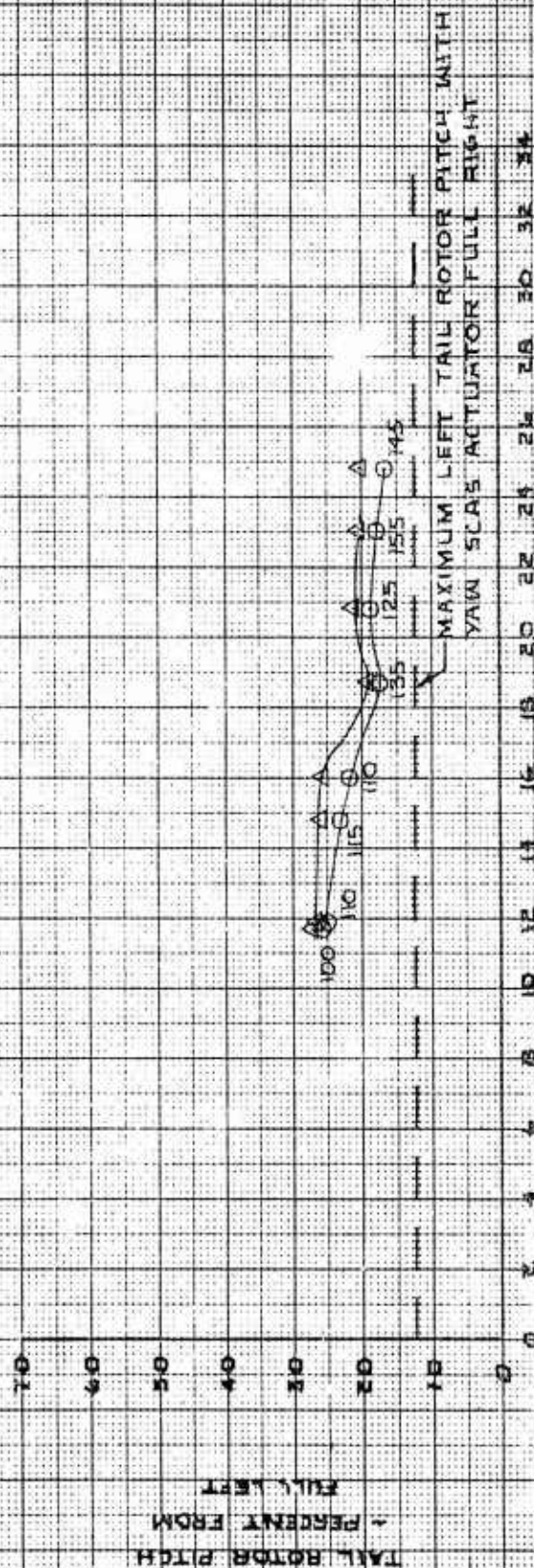
TRUE AIRSPEED ~ KNOTS (GROUND SPEED + WIND)

Figure No. 45

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 90°

AH-1 USA SN 41-5244

GROSS WEIGHT   C.G. STATION   DENSITY ALTITUDE   ROTOR SPEED
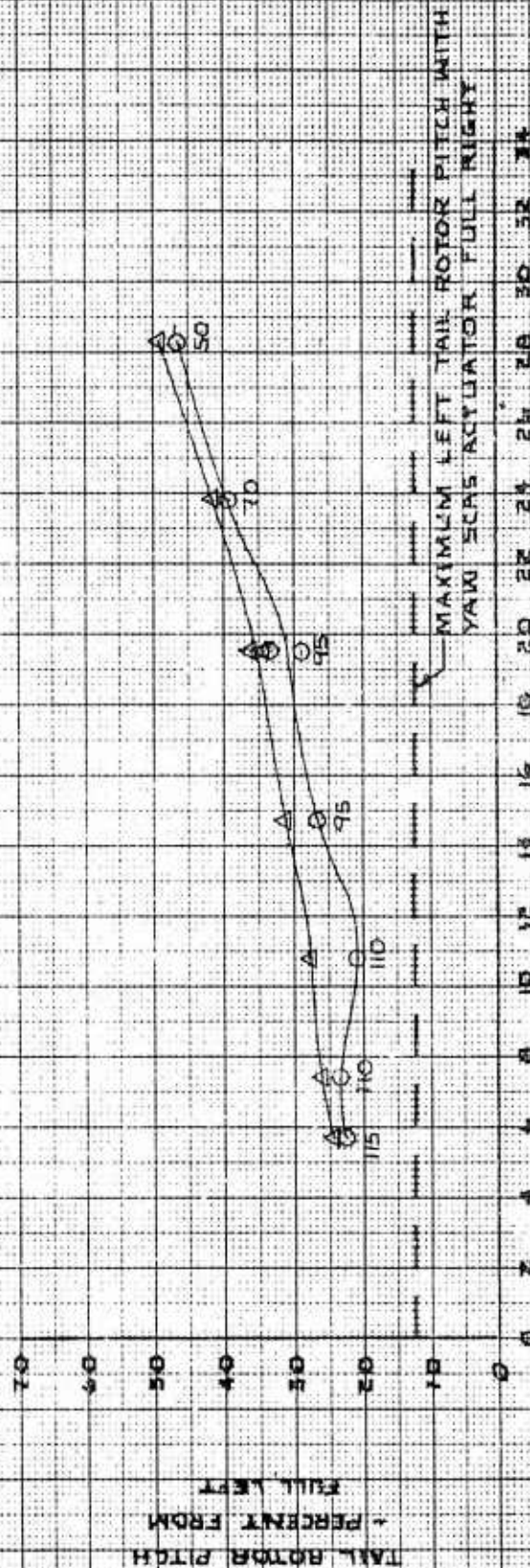9040 LBS   193.7 IN.   -130 FT.   324 RPM

NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL IS 18.1° TAIL ROTOR PITCH WITH SCAS NULL.
3. GROUND SPEED DETERMINED WITH CALIBRATED PACE CAR.
4. TRUE AIRSPEED DETERMINED BY VECTOR ADDITION OF GROUND SPEED AND WIND.
5. NUMBERS AT DATA POINTS ARE THE PEAK TAIL ROTOR SHAFT HORSEPOWERS RECORDED FOR THE POINT.

△ MEAN TAIL ROTOR PITCH
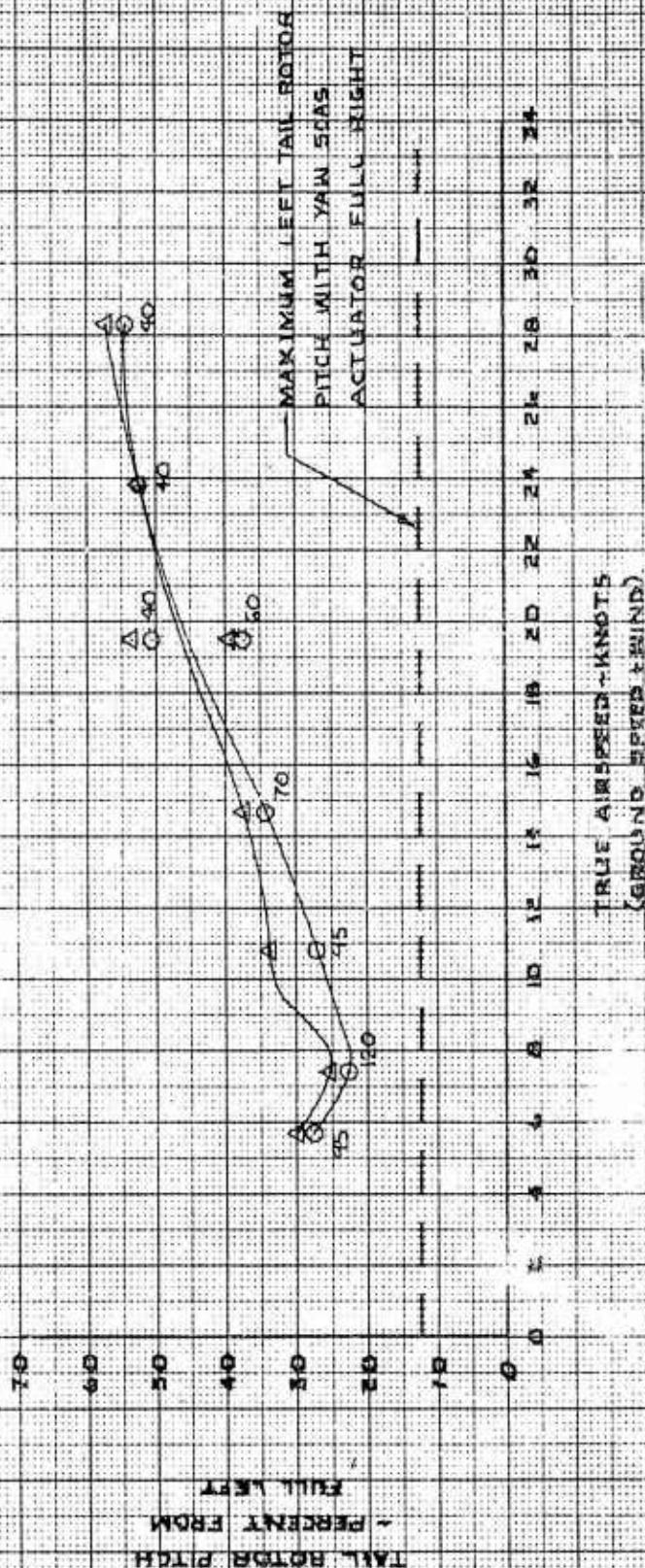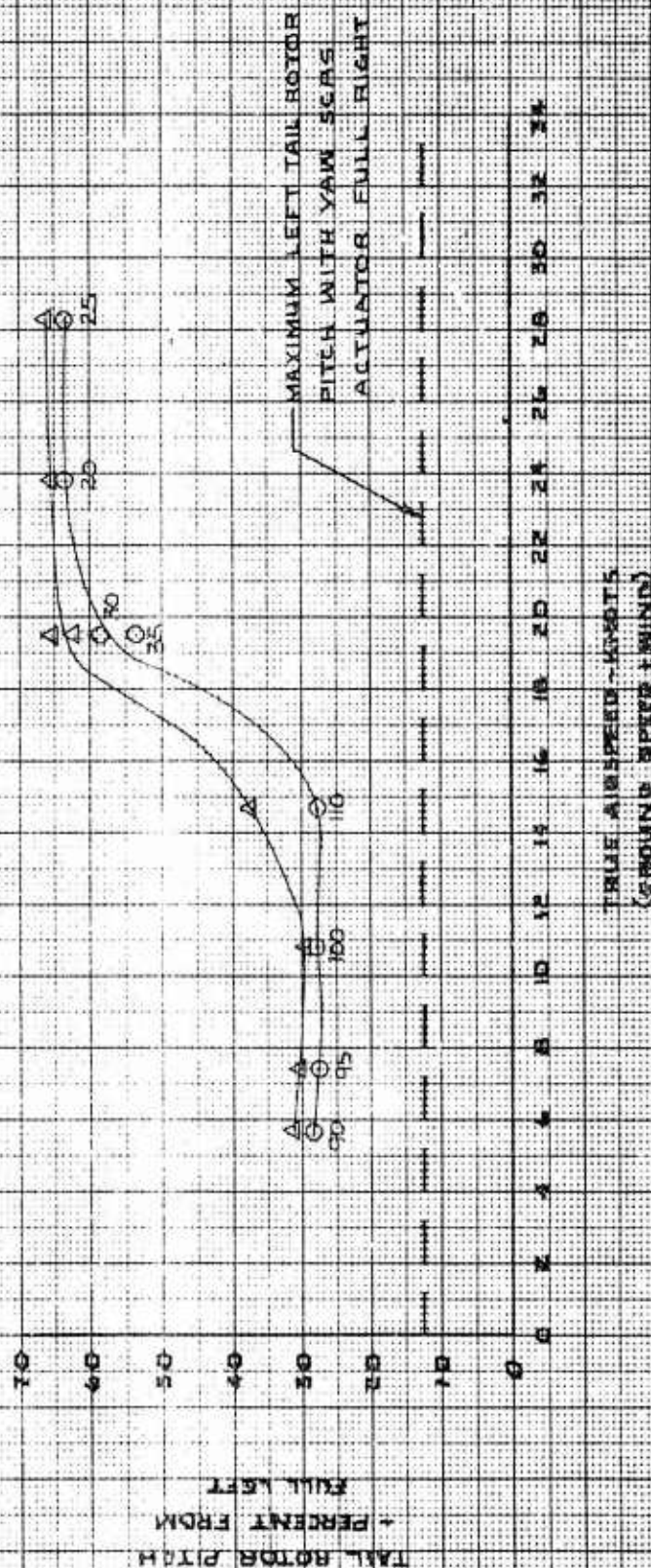○ MAXIMUM TAIL ROTOR PITCH USED DURING POINT
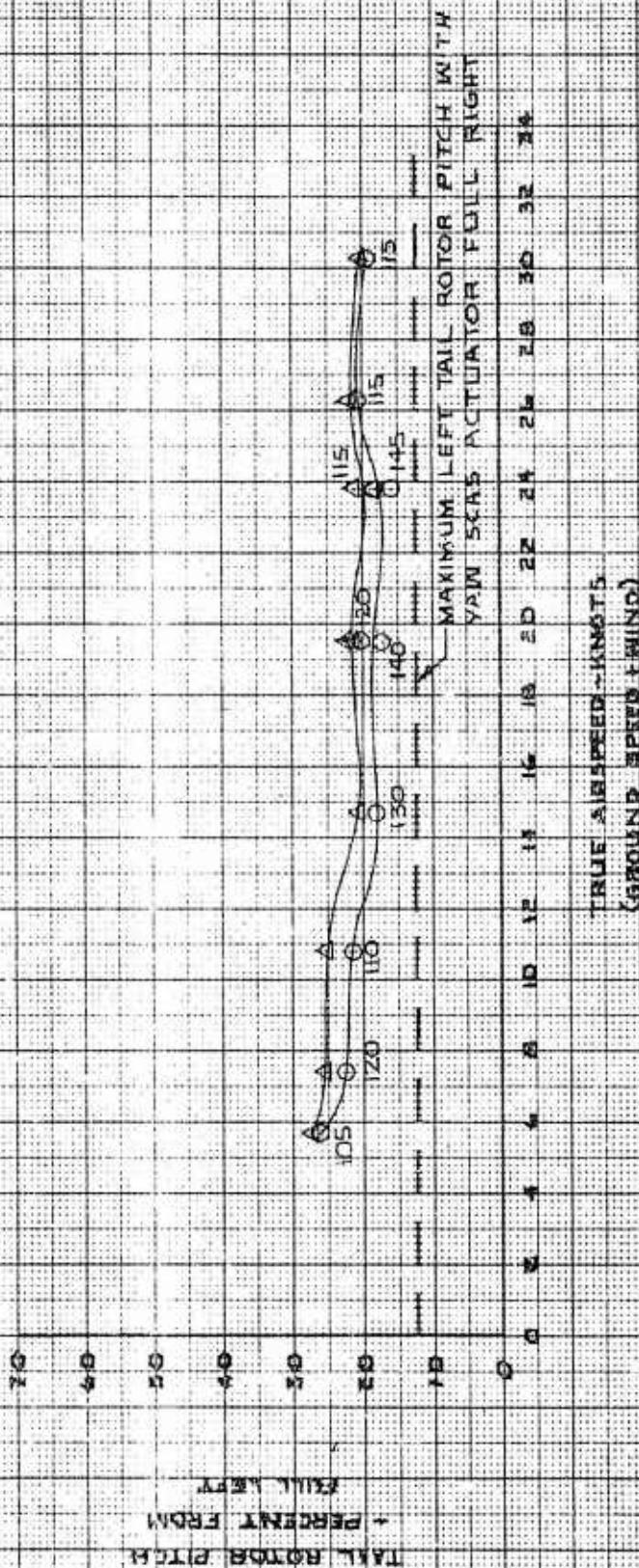
Figure No. 47

TAIL ROTOR PITCH REQUIRED WITH WIND AZIMUTH 110°
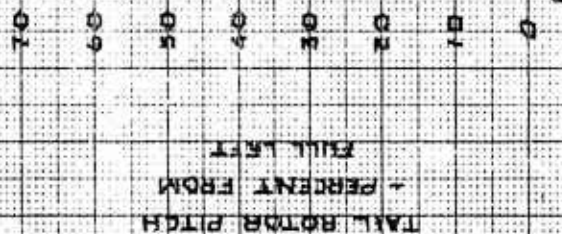
Figure No. 48
HOVERING TURN IN WIND

AH-1G USA S/N 615246

GROSS WEIGHT	C.G. STATION	DENSITY ALTITUDE	ROTOR SPEED
9130 LBS.	192.5 IN	8760 FT.	324 RPM

NOTES:
1. WIND GUSTING FROM ZERO TO APPROXIMATELY 8 KNOTS
2. TRACTOR TAIL ROTOR
3. FULL LEFT PEDAL ≈ 19.1° TAIL ROTOR PITCH WITH SCAS NULL.

△ MEAN TAIL ROTOR PITCH

○ MAXIMUM TAIL ROTOR PITCH
   USED DURING POINT

TAIL ROTOR PITCH ~ PERCENT FROM FULL LEFT

WIND AZIMUTH ~ DEGREES FROM NOSE

MAXIMUM LEFT TAIL ROTOR PITCH WITH YAW SCAS ACTUATOR FULL RIGHT
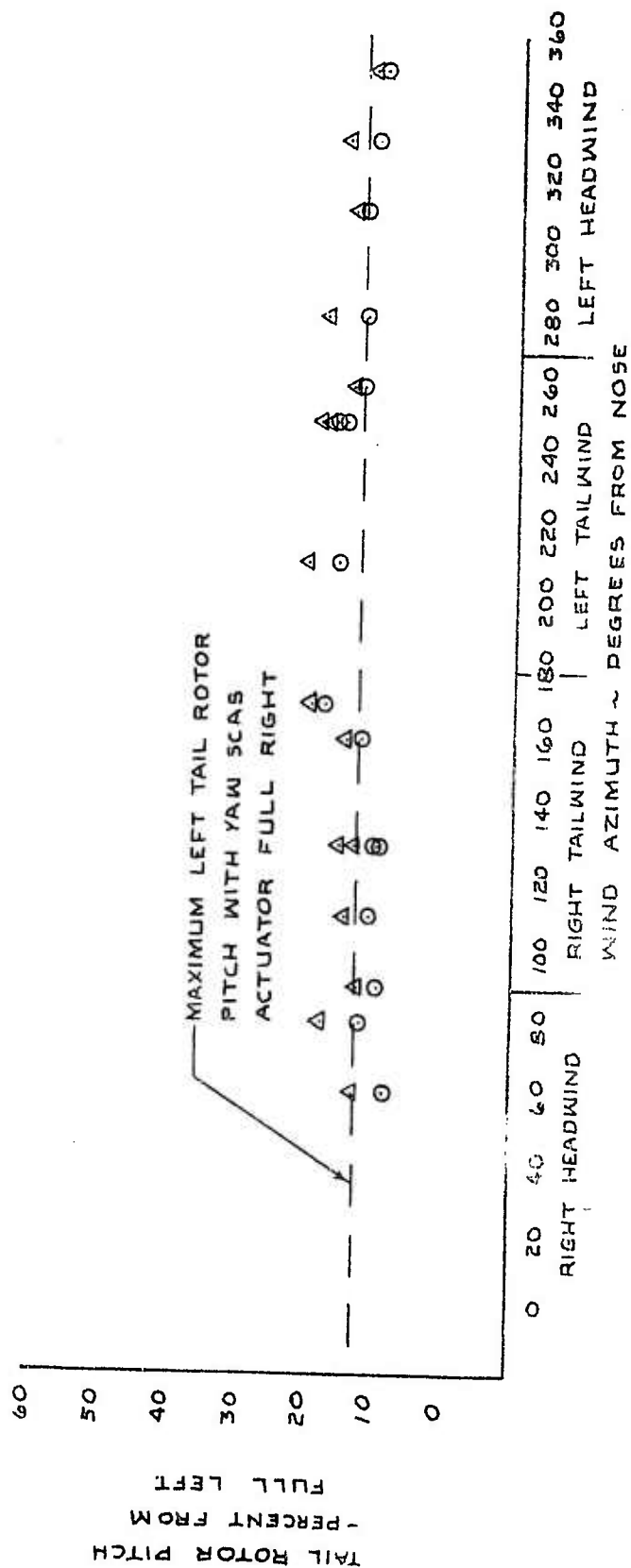
FIGURE No. 49
TAIL ROTOR SHAFT HORSEPOWER TO
ARREST RIGHT HOVERING TURN
AH-1G USA S/N 615246

SYM	GROSS WEIGHT ~ LBS.	C.G. STATION ~ IN.	DENSITY ALTITUDE ~ FT.	ROTOR SPEED ~RPM
■	9100	192.5	8750	324
O	8100	192.7	7920	324

NOTES:
1. WIND LESS THAN APPROXIMATELY 8 KNOTS.
2. PEDAL INPUT COMPLETED IN LESS THAN
   APPROXIMATELY 1.5 SECONDS.
3. TRACTOR TAIL ROTOR
4. FULL LEFT PEDAL = 19.1° TAIL ROTOR PITCH
   WITH SCAS NULL.

SIZE OF PEDAL INPUT TO ARREST TURN
~ PERCENT OF FULL TRAVEL
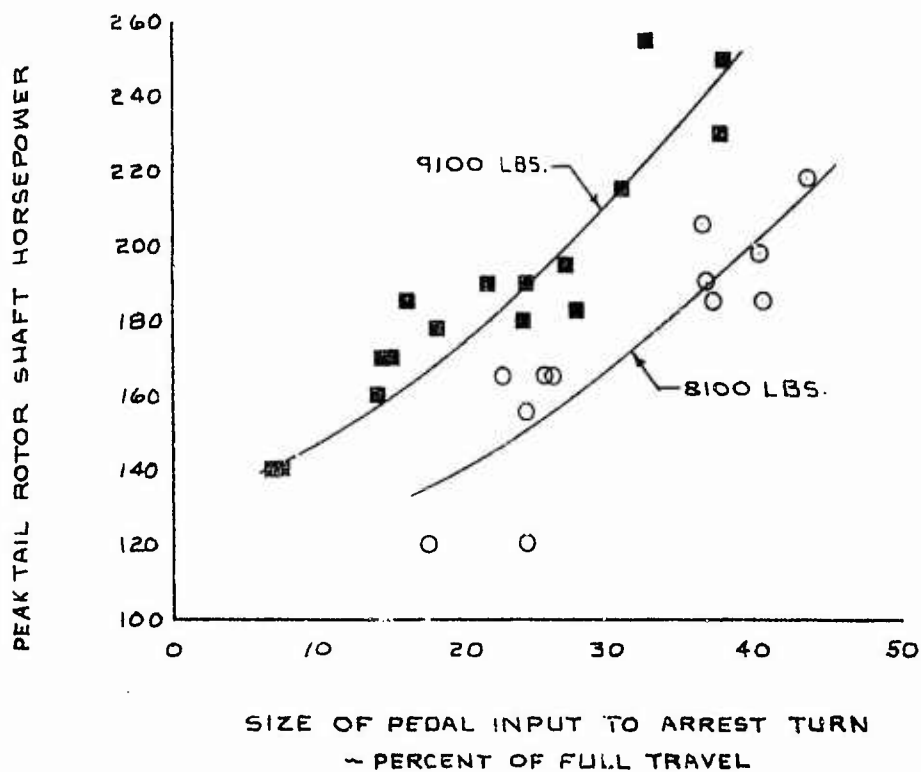
Table 2. Peak Tail Rotor Shaft Horsepower During Paced Flight AH-1G Helicopter S/N 615246.

NOTES:
1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL = 19.1° TAIL ROTOR PITCH WITH SCAS NULL

GROSS WEIGHT • DENSITY ALTITUDE • ROTOR SPEED
8030 lbs   7330 ft   324 rpm

AZIMUTH ~ DEGREES	AIRSPEED ~ KNOTS / PEAK TAIL ROTOR SHAFT HORSEPOWER							
20	3.9	7.2	11.0	15.6	20.8	25.8	29.8	
	90	90	85	85	85	75	65	
40	3.9	7.2	11.0	12.9	15.6	20.8	25.8	
	100	95	95	95	100	115	110	
70	3.9	7.2	11	12.9	15.6	20.8	25.8	
	105	95	110	115	140	175	125	
90	3.9	7.2	11	12.9	15.6	20.8	25.8	29.8
	110	95	110	105	155	165	125	135
120	3.9	7.2	11	12.9	15.6	20.8	25.8	
	105	115	110	95	140	115	95	
140	3.9	7.2	11	12.9	15.6	20.8	25.8	
	95	115	110	115	105	120	85	
160	3.9	7.2	11	12.9	15.6	20.8	25.8	
	95	125	120	125	140	80	60	
180	3.9	7.2	8.5	11	12.9	15.6	20.8	25.8
	105	120	125	125	135	70	85	65
200	3.9	7.2	11	15.6	20.8	25.8		
	105	115	115	55	45	60		
215	3.9	7.2	11	12.9	17.6	25.8		
	100	105	120	135	45	20		
320	3.9	7.2	11	12.9	15.6	20.8	25.8	29.8
	90	90	95	80	75	30	40	30

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Table 3. Peak Tail Rotor Shaft Horsepower During Paced Flight
AH-1G Helicopter S/N 615246.

NOTES: 1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL = 19.1° TAIL ROTOR PITCH WITH SCAS NULL

GROSS WEIGHT 8020 lbs • DENSITY ALTITUDE 7790 ft • ROTOR SPEED 314 rpm

Legend:
- Top value in each cell = AIRSPEED ~ KNOTS
- Bottom value in each cell = PEAK TAIL ROTOR SHAFT HORSEPOWER

Each cell below is shown as `airspeed / peak tail rotor shaft horsepower`.

AZIMUTH ~ DEGREES (RELATIVE WIND)								
30	3.9 / 82	7.2 / 78	11 / 82	12.9 / 82	15.6 / 93	20.8 / 73	25.8 / 102	29.8 / 82
70	3.9 / 92	7.2 / 107	11 / 97	12.9 / 116	15.6 / 102	15.6 / 126		
90	3.9 / 97	7.2 / 121	11 / 131	12.9 / 131	15.6 / 140	17.8 / 150		
120	3.9 / 97	7.2 / 111	11 / 78	12.9 / 92	15.6 / 116	20.8 / 107	25.8 / 97	29.8 / 111
150	3.9 / 111	7.2 / 111	11 / 131	12.9 / 116	15.6 / 107	21.5 / 87	25.8 / 68	30.5 / 78
180	3.9 / 107	7.2 / 116	11 / 140	12.9 / 160	15.6 / 92	20.8 / 97	25.8 / 87	
210	3.9 / 97	7.2 / 87	11 / 102	12.9 / 102	15.6 / 126	20.8 / 44	25.8 / 39	29.8 / 39
240	3.9 / 102	7.2 / 121	11 / 155	12.9 / 58	15.6 / 34	20.8 / 24	25.8 / 15	29.8 / 15
270	3.9 / 87	7.2 / 97	11 / 116	12.9 / 140	15.6 / 87	20.8 / 73	25.8 / 19	
315	3.9 / 92	7.2 / 82	11 / 87	12.9 / 82	15.6 / 68	20.8 / 73	25.8 / 34	29.8 / 39

Table 4. Peak Tail Rotor Shaft Horsepower During Paced Flight AH-1G Helicopter S/N 615246.

NOTES:
1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL = 19.1° TAIL ROTOR PITCH WITH SCAS NULL

GROSS WEIGHT 8680 lbs • DENSITY ALTITUDE 7190 ft • ROTOR SPEED 324 rpm

RELATIVE WIND / AZIMUTH ~ DEGREES		C1	C2	C3	C4	C5	C6	C7	C8
35	AIRSPEED ~ KNOTS	3.6	8.7	10.2	12	14.6	19	24	28
	PEAK TAIL ROTOR SHAFT HORSEPOWER	110	95	105	110	120	120	110	110
65	AIRSPEED ~ KNOTS	3.4	7.2	11	12.9	15.6	19.1	19.8	
	PEAK TAIL ROTOR SHAFT HORSEPOWER	105	115	115	120	140	125	165	
90	AIRSPEED ~ KNOTS	3.9	7.2	11	12.9	15.6	19.1		
	PEAK TAIL ROTOR SHAFT HORSEPOWER	110	110	120	95	170	155		
110	AIRSPEED ~ KNOTS	3.9	7.2	11	12.9	15.6	19.4		
	PEAK TAIL ROTOR SHAFT HORSEPOWER	130	115	160	150	145	150		
140	AIRSPEED ~ KNOTS	5.5	10.6	13	15.8	18.5	22.5	29	32
	PEAK TAIL ROTOR SHAFT HORSEPOWER	115	110	145	110	110	145	120	105
160	AIRSPEED ~ KNOTS	3.9	7.2	11	12.9	15.6	20.8	25.8	29.8
	PEAK TAIL ROTOR SHAFT HORSEPOWER	110	100	100	120	90	95	80	80
180	AIRSPEED ~ KNOTS	3.9	7.2	11	12.9	15.6	20.8	25.8	29.8
	PEAK TAIL ROTOR SHAFT HORSEPOWER	110	135	150	130	80	85	75	55
200	AIRSPEED ~ KNOTS	3.9	7.2	11	12.9	15.6	20.8	25.8	29.8
	PEAK TAIL ROTOR SHAFT HORSEPOWER	90	145	125	150	55	40	40	30
280	AIRSPEED ~ KNOTS	4.5	7.6	11.6	13.2	17	21	26.4	31
	PEAK TAIL ROTOR SHAFT HORSEPOWER	95	105	110	125	145	65	25	20

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Table 5. Peak Tail Rotor Shaft Horsepower During Paced Flight
AH-1G Helicopter S/N 615246.

NOTES:
1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL = 19.1° TAIL ROTOR PITCH WITH SCAS NULL.

GROSS WEIGHT	DENSITY ALTITUDE	ROTOR SPEED
9510 lbs	-120 ft	324 rpm

AIRSPEED ~ KNOTS / PEAK TAIL ROTOR SHAFT HORSEPOWER

Relative Wind / Azimuth ~ Degrees	Airspeed ~ knots : Peak Tail Rotor Shaft Horsepower (pairs)
70	5.7:95, 7.4:110, 10.8:120, 14.7:125, 19.5:165, 23.8:165, 28.3:135
90	5.7:120, 7.4:135, 10.8:150, 14.7:155, 19.5:170, 23.8:130, 28.3:140
110	5.7:110, 7.4:115, 10.8:150, 14.7:165, 19.5:140, 19.5:115, 23.8:110, 28.3:120
130	5.7:120, 7.4:110, 10.8:115, 14.7:120, 14.7:100, 19.5:125, 23.8:105, 28.3:95, 23.8:85, 28.3:105
160	5.7:95, 7.4:100, 10.8:155, 14.7:115, 19.5:95, 23.8:95, 28.3:75
180	5.7:115, 7.4:110, 10.8:110, 14.7:95, 19.5:95, 19.5:95, 23.8:70, 28.3:50
200	5.7:95, 7.4:120, 10.8:95, 14.7:70, 19.5:60, 19.5:40, 23.8:40, 28.3:40
270	5.7:90, 7.4:95, 10.8:100, 14.7:110, 19.5:35, 19.5:30, 23.8:20, 28.3:25

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Table 6. Peak Tail Rotor Shaft Horsepower During Paced Flight
AH-1G Helicopter S/N 615246.

NOTES:
1. TRACTOR TAIL ROTOR
2. FULL LEFT PEDAL = 19.1° TAIL ROTOR PITCH WITH SCAS NULL

GROSS WEIGHT • DENSITY ALTITUDE • ROTOR SPEED
8940 lbs   -150 ft   324 rpm

RELATIVE WIND — AZIMUTH ~ DEGREES		PEAK TAIL ROTOR SHAFT HORSEPOWER / AIRSPEED ~ KNOTS								
50	PEAK TAIL ROTOR SHAFT HORSEPOWER	11.7	11.9	14.8	18.7	23	16	20.8	24.8	
	AIRSPEED ~ KNOTS	100	110	115	135	155	110	125	145	
70	PEAK TAIL ROTOR SHAFT HORSEPOWER	1.7	3.4	6.8	10.7	15.5	19.8	28.8	32.8	
	AIRSPEED ~ KNOTS	90	100	110	110	160	145	130	135	
90	PEAK TAIL ROTOR SHAFT HORSEPOWER	5.7	7.4	10.8	14.7	19.5	19.5	23.8	26.3	30.3
	AIRSPEED ~ KNOTS	105	120	110	130	120	140	145	115	115
110	PEAK TAIL ROTOR SHAFT HORSEPOWER	10.7	11.4	13.8	18.7	23.5	16.5	19.8	27.8	32.3
	AIRSPEED ~ KNOTS	100	95	105	95	160	95	105	115	110

APPENDIX III TEST INSTRUMENTATION

1. Flight test instrumentation was installed in the test helicopter by the contractor prior to the start of this evaluation. Although other test instrumentation was installed in the test aircraft only those items on the oscillograph used in data collection for this test will be specified below. All instrumentation was calibrated by the contractor and witnessed or approved by the USAAVNTA flight test engineer. The flight test instrumentation was maintained by the contractor throughout the test program. The following parameters were utilized during this test:

    Oscillograph:
        All flight control positions
        Tail rotor pitch (acme thread)
        Yaw attitude
        Tail rotor shaft torque
        SCAS actuator positions
        Engine torque
        Rotor speed

2. Additional items installed in the test aircraft specifically required for this test were:

    Pilot's Panel:
        Altimeter
        Outside air temperature gage
        Directional control position indicator
        Calibrated directional gyro
        Calibrated compass
        Tail rotor torque gage
        VHF radio

APPENDIX IV

AH-1G OPERATING LIMITATIONS

1. Limit airspeed (V_L):

    Power on - 120 KIAS for all configurations and gross
    weights up to 9500 lbs at density alti-
    tude up to 3000 feet. For all configura-
    tions, reduce airspeed 8 KIAS per 1000
    feet above 3000 feet.

    Power off - 120 KIAS.

2. Gross weight - Center of Gravity Envelope:

    Forward limit: Below 7000 lb, Fuselage Station
    (F.S.) 190. Linear decrease from F.S. 190 at
    7000 lb to F.S. 192.1 at 95000 lb.

    Aft limit: Below 7650 lb, F.S. 201. Linear decrease
    from F.S. 201 at 7650 lb to F.S. 200 at 9500 lb.

3. Sideslip limits: 5 degrees at 190 KCAS. Linear increase
    to 20 degrees at 60 KCAS.

4. Maximum load factor:

5. Sideward and rearward flight: 35 kt

6. Maximum turn rate: 40 degrees per second

7. Maximum tail rotor horsepower, interim value proposed by
    contractor: 200 hp (inspection required)

8. RPM limits (steady state):

    Power on - 6600 to 6400 engine rpm
               324 to 314 rotor rpm

    Power off - 304 to 339 rotor rpm
                transient lower limit 250 rotor rpm

    Power on during dives and maneuvers 319 to 324 rpm

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9. Temperature and pressure limits:
      Engine oil temperature   93°C
      Transmission oil temperature   110°C
      Engine oil pressure   25 - 100 psi (lb per sq in.)
      Transmission oil pressure   30 - 70 psi
      Fuel pressure   5 - 20 psi

10. T53L-13 Engine limits - installed:
      Normal rated power (maximum continuous)   625°C Exhaust gas
                                                 temperature (EGT)
      Military rated power (30-minute limit)   645°C EGT
      Starting and acceleration
          (5-second limit)   675°C EGT
      Maximum for starting and acceleration   760°C EGT
      Torque pressure   50 psi

APPENDIX V   DISTRIBUTION LIST

Agency	Test Plans	Equipment Failure Reports	Interim Reports	Final Reports
Commanding General				
US Army Aviation Materiel Command				
ATTN: AMSAV-EF	2	2	2	2
AMSAV-ERS	2	-	2	2
AMSAV-EAC	2	-	2	2
AMSAV-ADR	-	-	-	2
AMSAV-FL	-	-	-	1
AMSAV-W	2	-	-	2
	(wpns only)			(wpns only)
PO Box 209				
St. Louis, Missouri 63166				
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DOCUMENT CONTROL DATA - R & D

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1. ORIGINATING ACTIVITY *(Corporate author)*	2a. REPORT SECURITY CLASSIFICATION
US Army Aviation Test Activity (USAAVNTA) Edwards Air Force Base, California 93523	UNCLASSIFIED
	2b. GROUP

3. REPORT TITLE

FEASIBILITY TEST OF THE TRACTOR TAIL ROTOR MODIFICATION ON THE AH-1G HELICOPTER

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*

Final Report - 7 October through 31 October 1967

5. AUTHOR(S) *(First name, middle initial, last name)*

Gary C. Hall, Major, TC, US Army, Project Pilot
John R. Melton, Project Engineer

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
March 1968	76	8

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
b. PROJECT NO. USAAVNTA 66-06	N/A
c.	9b. OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)*
d.	N/A

10. DISTRIBUTION STATEMENT

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
N/A	Commanding General US Army Aviation Materiel Command ATTN: AMSAV-O, P. O. Box 209, Main Office St. Louis, Missouri 63166

13. ABSTRACT

A feasibility test of the tractor tail rotor modification of the AH-1G helicopter was conducted near Fort Worth, Texas (550-feet elevation), and Alamosa, Colorado (7535-feet elevation), during the period 7 October to 19 October 1967. This test was conducted to obtain quantitative flight test data to serve as a basis for determining if the tractor tail rotor modification proposed by the contractor for the AH-1G helicopter would correct the directional control problems which currently exist on the AH-1G helicopter with the standard tail rotor configuration. This test revealed that in-ground-effect (IGE) low speed directional control and IGE low speed dynamic directional stability were greatly improved by installation of the tractor tail rotor. IGE directional control limitations with the standard tail rotor installed were encountered at approximately 8100 pounds gross weight near sea level in previous tests. This test with the tractor tail rotor did not reveal any IGE directional control limitations at approximately 8940 pounds gross weight and near sea level. The test results indicate that additional directional control could be obtained with the tractor tail rotor, if the geometry of the directional control system were changed to negate the adverse effects of the stability and control augmentation system (SCAS) on the ability to obtain full left tail rotor pitch. The highest tail rotor horsepower encountered with large left pedal inputs to arrest hovering turns was 250 shaft horsepower. These tests proved that directional control deteriorated with increased gross weight, increased density altitude or decreased rotor speed. The test aircraft exhibited SCAS coupled pylon motion which has been a continuing problem on the AH-1G helicopter.

DD FORM **1473** 1 NOV 65

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
AH-1G helicopter						
Tractor tail rotor modification						
In-ground-effect						
Low speed directional control						
8100 pounds gross weight						
8940 pounds gross weight						
Control augmentation system						
250 shaft horsepower						